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CONTENTS

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AN OBJECTIVE METHOD OF FORECASTING PRECIPITATION 24–48 HOURS IN ADVANCE AT SAN FRANCISCO, CALIFORNIA

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This is the first report of a study aimed at developing an objective method for forecasting the occurrence of rain at San Francisco, Calif., applicable to the period 24–48 hours after map time. Primarily, incentive for the study stems from the urgent need to furnish improved rain forecasts for the second day in advance to operational planning units of agriculture, industry, and transportation. The study is confined to the winter season and does not in any way touch upon summer or early autumn rain conditions.

In the six parts of this report an effort is made to present the various steps in the development of the study, in the order of their occurrence. This presentation is intended to demonstrate that useful results may be obtained with a minimum of effort from a relatively small sample of data, by utilizing synoptic experience as a basis from which to start, proceeding to express that experience in numerical parameters, and subjecting each parameter finally to statistical tests.

HISTORY

The outstanding studies dealing with rainfall forecasting on the Pacific Coast have all resorted to map typing in one form or another. In 1932, Reed [1], following to a large extent the system previously applied by Abercromby [2] to the Atlantic, developed the first system of weather types for the Northeast Pacific. All maps were placed in one of six classifications—Northerly, Northwesterly, Westerly, Southwesterly, Southerly, or Easterly—based on the direction of the predominating air currents in the area under consideration, i. e., the Northeast Pacific Ocean.

Reed's system should be considered the parent of all weather typing systems thus far developed for the Northeast Pacific. Although excellent, it has perhaps not received due recognition because (1) it is entirely descriptive; (2) it is not illustrated but in lieu of illustrations gives references to maps which are not available to many readers; and (3) it is general in scope and does not develop objective methods for making forecasts for any specific point or definitely defined area.

In July 1943, Brown [3] published an article on rainfall forecasting for the Los Angeles area, making certain modifications in the map types developed by Reed, and developing a somewhat objective system of arriving at the forecasts. Later in the same year the California Institute of Technology [4] published an elaborate system of map types based largely on pressure field configurations and the position and intensity of the North Pacific subtropical anticyclone. Finally, in 1946, Thompson [5], following the work of Reed and Brown to a considerable extent, developed a purely objective system of making rainfall forecasts for the period from 6 to 24 hours after map time for Los Angeles, Calif.

No resumé of map typing efforts would be complete without mention of the noteworthy use of type maps made for many years by the Fruit Frost Service of the Weather Bureau under the supervision and direction of Floyd D. Young. Unfortunately, none of the map typing work done by the Fruit Frost Service has been published.

Although in many ways the study treated in this report resembles Thompson's study, it differs in four important respects: (1) it is designed for forecasting rainfall for San Francisco instead of Los Angeles; (2) it deals with forecasts for a period 24 to 48 hours in advance rather than 6 to 24 hours in advance; (3) in order to extend the forecast period to cover the second day after map time, there is consideration of the predominant air currents over an area far upwind in the directions from which rain-producing perturbations usually approach San Francisco, whereas in Thompson's study the prevailing currents over a more limited area were considered; and (4) secondary parameters, i. e., those applying within given types, are quite different from those used by Thompson.

CLASSIFICATION OF MAPS INTO MAJOR TYPES

Aptly pointed out by Reed [1] is the fact that the Pacific area is admirably suited for classification of weather maps according to direction of air streams, because " . . . the relative uniformity of temperature and equality of level of the oceanic surface permit the isobars to reflect in significant degree the strength and direction of the major air streams in the lower atmosphere." Reed classified his maps by subjective evaluation of the air streams. The first problem in the present study was to develop a numerical or objective method of classification, as Thompson [5] did in the Los Angeles study, by a determination of the meridional and zonal components of air movement in certain areas, based on measurement of pressure gradients. The areas in which these measurements were made were selected on the basis of their special significance to forecasting the weather for San Francisco.

It is a matter of common knowledge in synoptic meteorology that, under the more or less constant influences of the oceans and continents and the systematically varying influences of the seasons, atmospheric currents tend to become set up in certain preferred flow patterns. It appeared logical, in the development of a system for measuring the component parts of typical flow patterns from which map types would be determined, to start

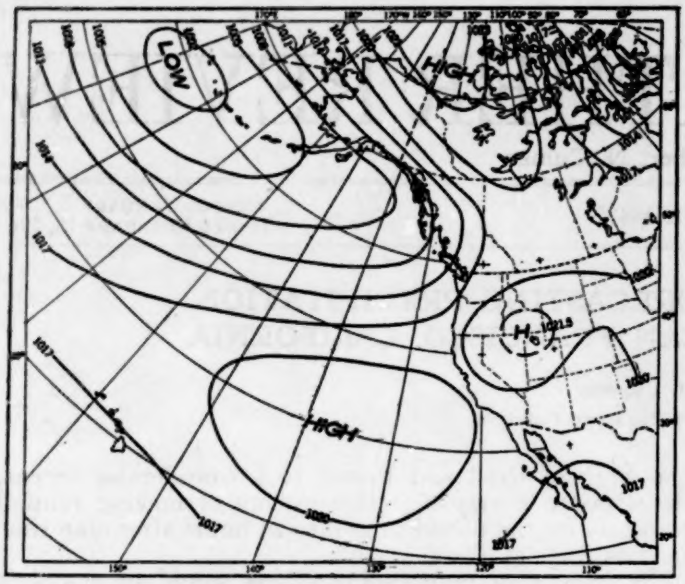

FIGURE 1(a).—Northerly Type map. 1200 G. C. T. January 11, 1935

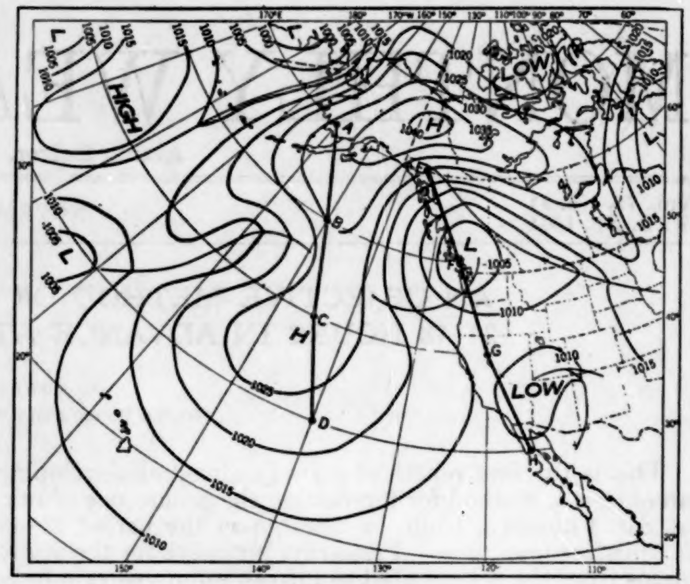

FIGURE 1(b).—Normal sea level pressure map for January

with measurements which would produce numerically large indications on those maps having the most unique flow patterns. Among the patterns, it is to be expected that the most unique would (a) depart most radically from normal patterns, or (b) accentuate the features of normal patterns.

By far the most unique of all the flow patterns observed in the Northeast Pacific is that described by Reed as the "Northerly Type," which coincides with Brown's "Type 2" and C. I. T. "Type A." An excellent example is shown in Figure 1(a). This type, which is characteristically rainy for San Francisco, represents an almost complete reversal of the normal pressure distribution, which can be seen by comparing Figure 1(a) with Figure 1(b). The former shows the Northerly Type map of January 11, 1935, 24 hours before the beginning of seven consecutive rainy days associated with the same map type, while the latter shows the normal sea level pressure distribution for January. While on the normal map pressure is relatively high along the continent and low at sea, the opposite is true of the Northerly Type map, on which the pressure is relatively low along the continent and high from 800 to 1,000 miles at sea.

In maps of the Northerly Type the predominant movement of rain-producing disturbances is from north to south, with a large positive (north-to-south) meridional flow along the coast and the adjacent ocean. In order to obtain a large positive meridional index on such a map, the difference in the pressures must be measured along two axes, one lying parallel to and near the axis of the controlling Pacific High cell and the other parallel to and touching upon the axis of the low pressure system dominating the coastal area.

It has been found that this result can be obtained [see Figure 1(a)] by subtracting the mean of pressures at points E, F, G, and H, which lie along a line approximating the mean position of the coastal troughs of Northerly Type maps, from the mean of pressures at points A, B, C, and D, which lie along a line approximating the normal axis of Highs associated with the same type. The value obtained is expressed symbolically as

$$\tfrac{1}{4}(A+B+C+D)-\tfrac{1}{4}(E+F+G+H)$$

and is referred to as M_a, or "Meridional A." In the map shown in Figure 1 (a) it amounts to 15 mb., which is large enough to satisfy the desire for a numerically large meridional index in typical Northerly Type maps.

The next step in testing the effectiveness of the tentatively selected meridional index points was to ascertan whether the same points would yield a numerically satisfactory negative meridional index on a Southerly Type map. The Southerly Type is the second most unique of Reed's classification, usually a fair-weather type for San Francisco, and represents an accentuation of certain features of the normal pressure distribution, with pressures higher than normal along the continent and lower than normal in the eastern Aleutians.

Figure 1(c) shows how the pressure values from the grid described in the preceding paragraph will produce a relatively large negative value for the meridional index when when applied to a typical Southerly Type map. The representative Southerly Type map of January 2, 1938, was followed after 24 hours by eleven consecutive days

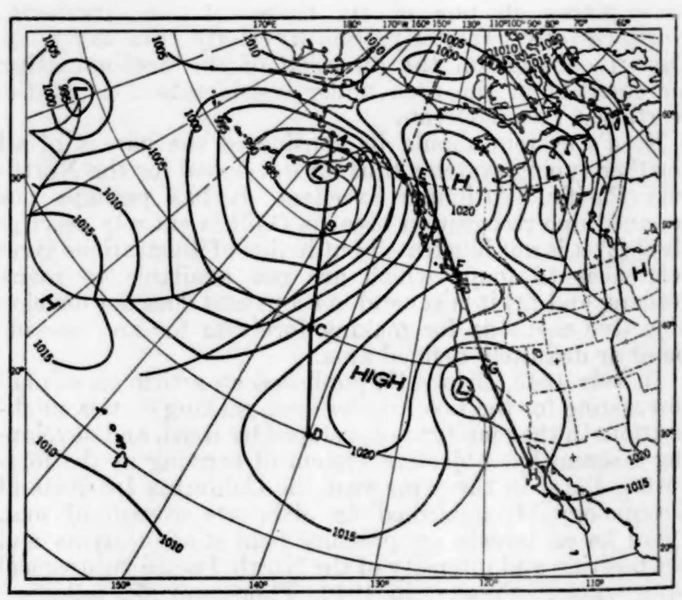

FIGURE 1(c).—Southerly Type map. 1200 G. C. T. January 2, 1938

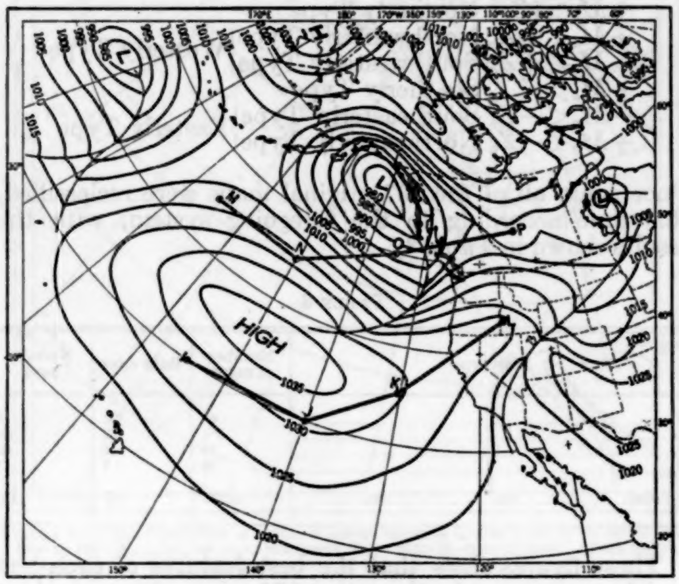

FIGURE 2(a).—Northwesterly Type map. 1200 G. C. T. January 1, 1933

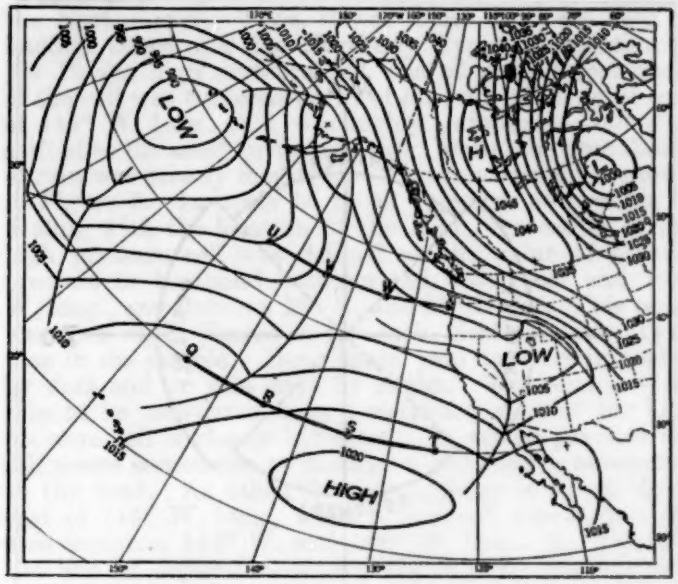

FIGURE 2(b).—Southwesterly Type map. 1200 G. C. T. February 16, 1936

of rainless weather at San Francisco. From it, the value of the meridional index, using the above formula, was computed as −8.0 mb., which indicated that the meridional axes selected would produce the desired large negative indices under Southerly Type conditions, as well as large positive indices under Northerly Type flow patterns.

Figures 2(a) and 2(b) illustrate the method for determining the zonal component of the local circulation. In Figure 2(a), points I, J, K, and L were selected, to be near the normal position of the axis of the Pacific high pressure cell as well as near the approximate average position of the center of the Plateau high pressure system when it exists. Points M, N, O, and P were selected to be roughly parallel to points I, J, K, and L, and to lie sufficiently far to the north of the latter to result in zonal indices numerically commensurate with the meridional indices obtained in the manner previously described. The zonal index was then obtained by subtracting the mean of the pressures at points M, N, O, and P from the mean of the pressures at I, J, K, and L. The value obtained is expressed symbolically as

$$\tfrac{1}{4}(I+J+K+L)-\tfrac{1}{4}(M+N+O+P)$$

and is referred to as Z_a, or "Zonal A."

After scaling off the local meridional and zonal indices, it is possible to classify a given map by plotting the indices on cartesian coordinates, illustrated in Figure 3. If the point plotted for a given map falls in the upper quadrant, a Northerly Type prevails; similarly, the other quadrants each indicate a specific type, as shown in Figure 3. However, it may be more convenient in actual practice to express the classification process symbolically as follows:

$+M_a>|Z_a|$ Northerly Type
$-M_a>|Z_a|$ Southerly Type
$+Z_a>|M_a|$ Westerly Type
$-Z_a>|M_a|$ Easterly Type

This system of typing was tested on a sample of 237 maps taken from eight winter months—January and February of 1933, 1935, 1936, and 1938—which were selected as being representative of a wide variety of map types. Table 1 shows the number of maps falling in each type and the number of maps followed by "rain" and "no rain" days under each type. A "rain" day was defined as one in which a measurable amount of rain occurred at the official gauge in downtown San Francisco between 24 and 48 hours after the time of the map under consideration. Traces of rain were counted as "no rain," unless they occurred at the beginning or end of a period of measurable precipitation.

Figures in the table, showing 35 rain days against 8 no rain days, support the conception that the Northerly Type is characteristically rainy, and indicates a satisfactory segregation of rain days into this type. Figures on the Southerly Type, showing 43 no rain days against 18 rain days, agree with the original concept that this is predominantly a no rain type, but they do not show the preponderance of no rain days which experience would lead one to expect. In an attempt to improve this segregation of no rain days, a new zonal index (Z_b) was tested. This index consisted of a mean of pressures along latitude 50° N., subtracted from a mean along latitude 35° N. The sample of maps was reclassified using M_a and Z_b, with no significant gain in the segregation, and Z_b was abandoned.

TABLE 1

Map type	Number of maps	Rain days	No rain days
N	43	35	8
W	119	49	70
S	61	18	43
E	14	5	9
Total	237	107	130

In a further attempt to improve the Southerly classification, all maps of this type were inspected, and it was found that a significant number of the maps followed by rain days were of the type shown in Figure 2(b). The indices used originally, M_a and Z_a, place this type of map in the Southerly classification. It was rather obvious, however, that, as far as California is concerned, the predominant flow is westerly. In order to bring about a Westerly instead of a Southerly Type classification, there

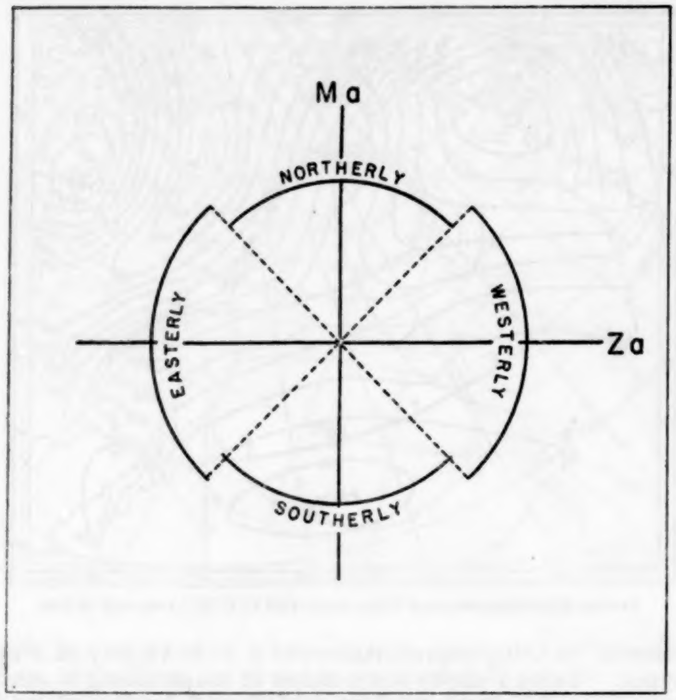

FIGURE 3.—Chart illustrating basis for plotting local meridional and zonal indices for a given map on cartesian coordinates to determine its type

must be a strongly positive zonal index. This can be obtained by computing the zonal index as the difference between the mean of pressures at points Q, R, S, and T along latitude 30° N., and U, V, W, and X along latitude 45°N. This index,

$$\tfrac{1}{4}\,(Q+R+S+T)-\tfrac{1}{4}\,(U+V+W+X),$$

is referred to a Z_c, or "Zonal C."

All of the 237 maps in the original sample were again reclassified, this time using M_a and Z_c. Results are shown in Table 2. Figures in this table show a segregation of no rain days for the Southerly Type as 62, against but 13 rain days, to be compared with 43 no rain days against 18 rain days resulting from the first attempt at classification, shown in Table 1. However, some skill was lost in this attempt at segregation relative to the Northerly Type maps. They show only 31 rain days against 14 no rain days, as compared with the first test ratio of 35 to 8.

TABLE 2

Map type	Number of maps	Rain days	No rain days
N.	45	31	14
W.	103	59	44
S.	75	13	62
E.	14	4	10
Total	237	107	130

Comparison of Tables 1 and 2 immediately suggested that the next step should be to combine the best features of each classification and obtain a high degree of segregation of no rain days under the Southerly Type without loss of the excellent segregation of rain days under the Northerly Type. This was accomplished by the simple expedient of first measuring the meridional index, M_a. If positive, it was used in conjunction with Z_a, and if negative, with Z_c. The table given below expresses this symbolically.

$+M_a>|Z_a|$ Northerly Type

$\left.\begin{array}{l}+M_a<+Z_a \text{ Northwesterly Type}\\ -M_a<+Z_c \text{ Southwesterly Type}\end{array}\right\}$ Westerly Type

$-M_a>|Z_c|$ Southerly Type

$\left.\begin{array}{l}-M_a<-Z_c \text{ Southeasterly Type}\\ +M_a<-Z_a \text{ Northeasterly Type}\end{array}\right\}$ Easterly Type

Once again all of the 237 original maps were reclassified, this time according to the foregoing system, with the results shown in Table 3.

TABLE 3

Map type	Number of maps	Rain days	No rain days
N.	43	35	8
W.	101	52	49
S.	75	13	62
E.	18	7	11
Total	237	107	130

These figures show that the best features of each test had been preserved: the ratio of 35 rain to 8 no rain days was retained for the Northerly Type maps, and 63 no rain to 13 rain days for the Southerly Type. This led to a decision to use the latter criteria for classification of January and February maps.

TREATMENT OF INDIVIDUAL TYPES

Northerly Type.—The next problem in the study was to effect a satisfactory segregation of rain and no rain days within each individual type. Beginning with the Northerly Type, an attempt was made to show a relationship between the location and strength of the Pacific high pressure cell and the occurrence of rain. One of the preconceived hypotheses was that rain occurring with a Northerly Type map was dependent to some extent on the position of this cell. No relationship could be demonstrated, however, and it was concluded that while location and strength of the high pressure cell are important factors in determining the map type, they are of no further help in separating the rain days from no rain days within the type.

Study of the entire group of Northerly Type maps in the sample revealed that when the large area of low pressure associated with this type shifts rather far eastward or southward, rain at San Francisco terminates. However, it was rather difficult to define the center of this large Low, due to the fact that once it is centered east of the coast, it becomes broken up into several more or less related centers. It was finally found that fairly good separation of rain from no rain days within the Northerly Type could be obtained by plotting the point of lowest pressure in the area bounded approximately by 37° N. and 60° N. lat. (or the Aleutian Islands chain), and 110° W. and 170° W. long. A plot of these positions for the original sample of 43 Northerly Type maps is shown in Figure 4. Dots indicate rain days; and circles, no rain days. The actual area considered in selecting the point of lowest pressure is outlined. The smoothed curve was drawn to separate as far as possible the rain and no rain points. Final location of this curve was determined by deciding upon what position would give the highest skill score in the forecast verification that follows.

By forecasting rain for each case when the point fell to the left of the line of separation, and no rain when it fell to the right, the following verification scores were obtained, using all the days included in the sample of Northerly Type maps, i. e., the data plotted in Figure 4.

FIGURE 4.—Plotted positions of points of lowest pressure in area from 37° to 60° N. lat., 110° to 170° W. long., for each Northerly Type map in sample data. (Dots indicate rain; circles, no rain, occurring between 24–48 hours after map time.)

TABLE 4

		FORECAST		
		Rain	No rain	Total
OBSERVED	Rain	35	0	35
	No rain	5	3	8
	Total	40	3	43

Percent correct=88
Skill score [1]=.80

Considering the fact that the forecast is for the second day in advance, i. e., 24 to 48 hours from map time, both the percent correct, 88, and the skill score of .80 may be regarded as excellent. While the study of additional cases and the use of additional parameters might yield a higher skill score, the magnitude of possible improvement was limited enough to justify dropping investigation of this map type temporarily to proceed with the study of other types.

Northwesterly Type.—In the finally adopted system of classification, M_a was used with Z_a if the meridional index was positive, and with Z_c if it was negative. This resulted in some of the Westerly Type maps being based on Z_a, some on Z_c. To separate these, the Westerly Types utilizing Z_a are referred to as Northwesterly, since they involve a positive (north-to-south) meridional component of flow; those utilizing Z_c are referred to as Southwesterly, because they involve a negative (south-to-north) meridional component.

[1] The skill score, S_c, in this study is defined by

$$S_c=\frac{C-E_c}{T-E_c},$$

where C=number of correct forecasts,
E_c=number of forecasts expected to be correct due to chance, and
T=total number of forecasts.

It has a value of unity when all forecasts are correct, and zero when the number of correct forecasts is equal to the number expected to be correct due to chance. In this study, the number of forecasts expected to be correct by chance is defined as the number expected correct from an equal number of random forecasts of rain days and no rain days, with the proportion of rain days to no rain days in accordance with climatological averages for the forecast period. Hence, the number of forecasts expected to be correct on this basis may be determined by

$$E_c=R\times f_r+N\,(1-f_r),$$

where R=observed number of rain days,
N=observed number of no rain days, and
f_r=relative frequency of occurrence of rain days during the period covered by forecasts, determined from climatological data (Example: if during a given period of 70 days it rains on the average of 23 days, f_r would be $^{23}/_{70}$).

In attempting to separate rain from no rain cases in the Northwesterly Type, it was found that, contrary to findings concerning the Northerly Type, the location of the Pacific high pressure cell was of great importance. If the cell was centered north of latitude 30° N. and east of 145° W. long., rain was highly improbable; but if it shifted to the south or west of these limits, the probability of rain was greatly increased. This relationship is shown in Figure 5. In order to be as objective as possible in dealing with the location of the High, the center of the high pressure cell was defined as the point of highest pressure to be found between the west coast and 160° W. long., and between 20° N. and 50° N. lat. This point was plotted, in Figure 5, for each Northwesterly Type map in the sample. Here, again, rain days are indicated by dots and no rain days by circles. The tendency for rain to be associated with a westward shift of the high pressure cell is clearly indicated. In actual practice the cell seems sometimes to undergo a progressive movement to the west. At other times it appears to break down east of 145° W. long., while a new cell moves into the area between 145° W. and 160° W. long. In Figure 5 the line of separation giving the highest possible skill score was drawn between rain and no rain points. Forecasts made from these data, based on this line of separation, would have given the following verification scores.

TABLE 5

		FORECAST		
		Rain	No rain	Total
OBSERVED	Rain	15	2	17
	No rain	3	19	22
	Total	18	21	39

Percent correct=87
Skill score=.74

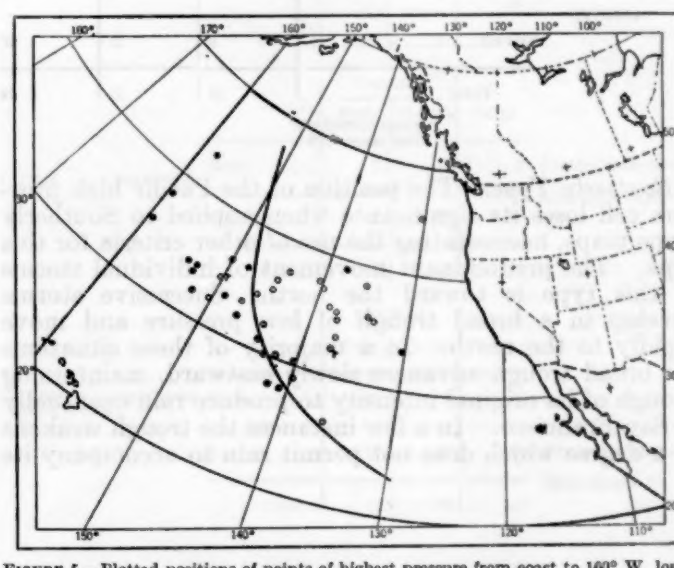

FIGURE 5.—Plotted positions of points of highest pressure from coast to 160° W. long., 20° to 50° N. lat., for each Northwesterly Type map in sample data. (Dots indicate rain; circles, no rain, occurring between 24–48 hours after map time.)

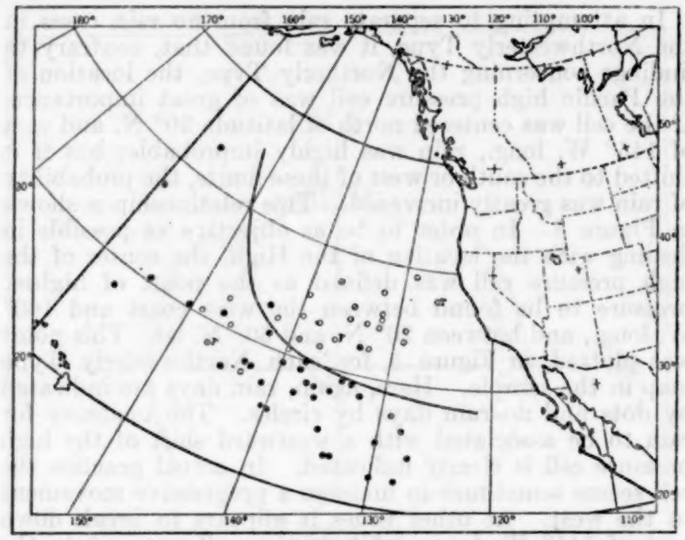

FIGURE 6.—Plotted positions of points of highest pressure from coast to 160° W. long., 20° to 50° N. lat., for each Southwesterly Type map in sample data. (Dots indicate rain; circles, no rain, occurring between 24–48 hours after map time.)

Southwesterly Type.—This type, defined as one in which $-M_a < +Z_e$, was treated in much the same manner as the Northwesterly. It is known that, as suggested by the type name, the Pacific high pressure cell usually shifts to the south or the southwest prior to the onset of rain, although there are a few cases in which it simply weakens while a stronger high pressure cell appears farther west or northwest, as in the Northwesterly Type. Figure 6 represents the plot of positions of the center of the high pressure cell for all cases of Southwesterly Type maps found in the original sample maps. Here again the center of the High was defined as the point of highest pressure between the West Coast and 160° W. long., and between 20° and 50° N. lat. The line of separation which was drawn between rain and no rain days yielded the following verification scores for forecasts made from these sample data.

TABLE 6

		FORECAST		
		Rain	No rain	Total
OBSERVED	Rain	33	2	35
	No rain	6	21	27
	Total	39	23	62

Percent correct=87
Skill score=.75

Southerly Type.—The position of the Pacific high pressure cell loses its significance when applied to Southerly Type maps, necessitating the use of other criteria for this type. The predominant movement of individual storms of this type is toward the north. Successive storms develop in a broad trough of low pressure and move rapidly to the north. In a majority of these situations the broad trough advances slowly eastward, maintaining enough of its original intensity to produce rain eventually at San Francisco. In a few instances the trough weakens to a degree which does not permit rain to accompany its passage over the coast. It was found that both the intensity and the proximity of the trough, as related to its potentialities as a rain producer for the second day in advance, can be judged rather successfully from pressures at 35° N. lat., 130° W. long., and 35° N. lat., 140° W. long. Figure 7 shows a plot of these points for all of the Southerly Type maps in the original sample. Pressures at 35° N., 130° W., were plotted as abscissa, while those at 35° N., 140° W., were plotted as ordinates. Dots indicate rain days; circles, no rain days. The line of separation which was drawn between rain and no rain days in this case gave the following verification scores for forecasts made from these sample data.

TABLE 7

		FORECAST		
		Rain	No rain	Total
OBSERVED	Rain	8	5	13
	No rain	2	60	62
	Total	10	65	75

Percent correct=91
Skill score=.77

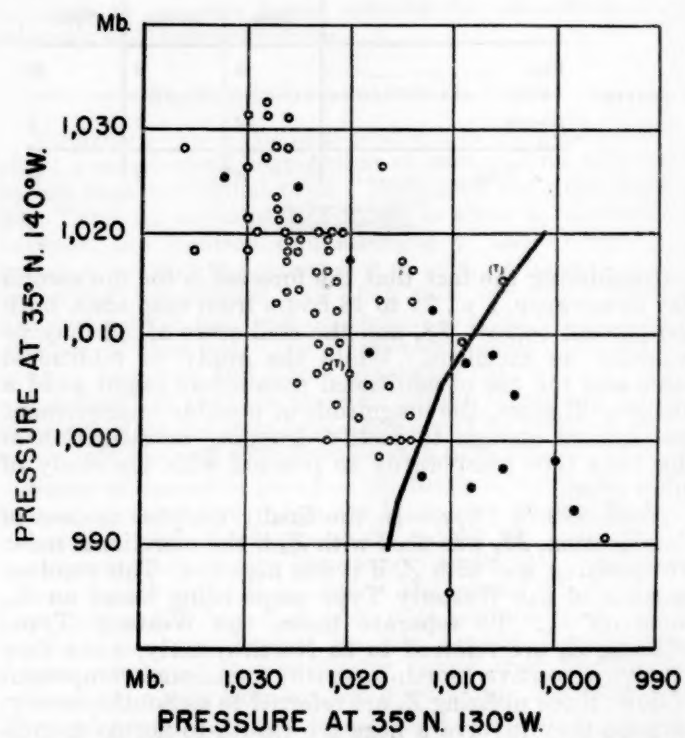

FIGURE 7.—Plotted pressures for designated latitude and longitude for each Southerly Type map in sample data. (Dots indicate rain; circles, no rain, occurring between 24–48 hours after map time.)

Verification scores for all types exclusive of Easterly.—Since there were but 18 cases of Easterly Type maps in the original sample, these were not treated at this stage of the study but were laid aside for later consideration. Combining verification scores for all cases in the original sample, exclusive of the Easterly Type, gives the following score.

TABLE 8

OBSERVED		FORECAST Rain	No rain	Total
	Rain	91	9	100
	No rain	16	103	119
	Total	107	112	219

Percent correct = 89
Skill score = .77

TEST OF SYSTEM ON INDEPENDENT DATA

By the usual standards the scores obtained from the original data may be regarded as excellent for forecasts of rain or no rain 2 days ahead. The question immediately arose, however, as to whether the system would produce comparable results when applied to independent data. It was decided to test the system by applying it to independent data taken from 4 months of December and 4 of March. The months used were December of 1931, 1932, 1933, and 1934, and March of 1932, 1933, 1934, and 1935.

Verification of the December forecasts made by use of this system is given in Table 9, while Table 10 shows similar data for the March forecasts. These two tables, along with January and February verifications of original data, are summarized and compared in Table 11. They indicate definitely that the system holds nearly as well for both December and March as it did for January and February.

The over-all skill on all map types for the various months is compared in Table 12. Perhaps it should be pointed out that lower skill scores should be expected in March since the normal predominance of no-rain weather in that month is greater than in December, January, or February.

TABLE 9.—*Verification of test data for months of December 1931, 1932, 1933, and 1934*

Type	Observed	FORECAST Rain	No rain	Total	
N TYPE	OBSERVED Rain	12	0	12	Percent correct = 82
	No rain	3	2	5	Skill score = .70
	Total	15	2	17	
NW TYPE	OBSERVED Rain	11	1	12	Percent correct = 89
	No rain	2	14	16	Skill score = .77
	Total	13	15	28	
SW TYPE	OBSERVED Rain	21	1	22	Percent correct = 88
	No rain	4	16	20	Skill score = .76
	Total	25	17	42	

TABLE 9.—*Verification of test data for months of December 1931, 1932, 1933, and 1934*—Continued

Type	Observed	FORECAST Rain	No rain	Total	
S TYPE	OBSERVED Rain	0	7	7	Percent correct = 77
	No rain	0	24	24	Skill score = .42
	Total	0	31	31	
COMBINED (N, NW, SW, S Types)	OBSERVED Rain	44	9	53	Percent correct = 85
	No rain	9	56	65	Skill score = .66
	Total	53	65	118	

TABLE 10.—*Verification of test data for months of March 1932, 1933, 1934, and 1935*

Type	Observed	FORECAST Rain	No rain	Total	
N TYPE	OBSERVED Rain	13	0	13	Percent correct = 78
	No rain	4	1	5	Skill score = .64
	Total	17	1	18	
NW TYPE	OBSERVED Rain	3	0	3	Percent correct = 81
	No rain	4	14	18	Skill score = .43
	Total	7	14	21	
SW TYPE	OBSERVED Rain	11	1	12	Percent correct = 77
	No rain	9	24	33	Skill score .41
	Total	20	25	45	
S TYPE	OBSERVED Rain	3	0	3	Percent correct = 100
	No rain	0	30	30	Skill score = 1.00
	Total	3	30	33	
COMBINED (N, NW, SW, S TYPES)	OBSERVED Rain	30	1	31	
	No rain	17	69	86	Percent correct = 85
	Total	47	70	117	Skill score = .60

Table 11.—*Summary of verification scores on original sample data (Jan., Feb.) and test data (Dec., Mar.)*

Months	N Type		NW Type		SW Type		S Type		N, NW, SW, S Types	
	Skill score	Percent correct	Skill score	Percent correct	Skill score	Percent correct	Skill score	Percent correct	Skill score	Percent correct
Jan.-Feb.	.80	88	.74	87	.75	87	.77	91	.77	89
Dec.	.70	82	.77	89	.76	88	.42	77	.68	85
Mar.	.64	78	.43	81	.41	77	1.00	100	.60	85

Table 12

	Jan. and Feb.	Dec.	Mar.
Skill score	.77	.68	.60
Percentage correct	89	85	85

Examination of Table 11 shows that the skill in forecasts from Southerly Type maps was appreciably lower in December (.42) than in January and February (.77). By reference to Table 9 it can be seen that this resulted from seven cases in which no rain was forecast and rain was observed. Upon examination of the maps on which these failures occurred, it was noted that most of them behaved as Northerly rather than Southerly Types. Their classification as Southerly was brought about by the fact that the pressure points used in determining the meridional index were too far west to obtain a representative index for December. This appears to be closely related to the frequent prevalence of blocking mechanisms in December, with relatively less significance attributable during that month to pressures west of the Pacific Coast. Consideration suggests that during the early part of the rainy season, i. e., November and December, the meridional index might be determined from pressures at points located about 5 degrees east of those found most satisfactory for January and February. This supposition will be tested in future studies.

In contrast with December, the verification of March data indicates the highest possible skill score on Southerly Type maps. Blocking mechanisms are relatively less frequent on the Pacific Coast in March than in December. Hence, the pressure points set up for determining the meridional index in January and February work with greater success in March than in December.

The tests indicated that skill in dealing with Northwesterly and Southwesterly Types will be lower in March than in January and February. In Table 11 it is seen that for the Northwesterly Type the skill score for March was but .43 as compared to .74 for January and February. For the Southwesterly Type the scores were .41 for March and .75 for January and February. Reference to Table 10 shows that the loss of skill in Northwesterly and Southwesterly Types for March was brought about by forecasting rain which did not occur. It will be recalled that the forecast for these types is based on the position of the Pacific High. No account is taken of location of Lows or of the pressure values at or near San Francisco. It appears that in March the mere shifting southward or westward of the high pressure center is not as significant as it is in midwinter. Some other variable, such for example as the pressure value at some critical point upwind from San Francisco, may have to be used in conjunction with the location of the high pressure center if scores for forecasts on these types comparable to the January and February forecast scores are to be obtained. The high pressure cells in March are often so strong and extensive that the pressure upwind from San Francisco may not drop to values normally associated with rain even when the center of the cell drops far to the south or west of its normal position. It is also possible that verification of these types for March might be improved by drawing up special graphs similar to Figures 5 and 6 but based solely on March data.

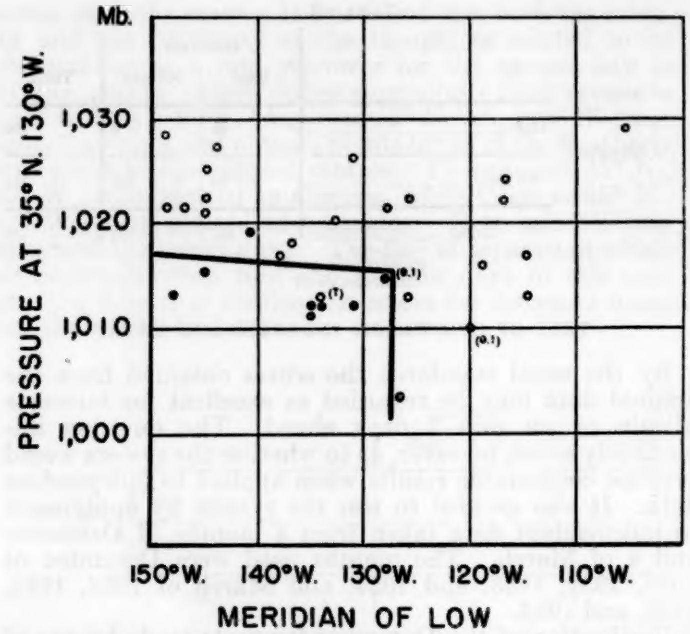

Figure 8.—Pressure at 35° N. lat., 130° W. long., plotted against the meridian of the most westerly low center lying between 105° to 150° W. long., for all Easterly Type maps, December through March

Notwithstanding the difficulties encountered in dealing with Southerly Type maps in December and with Northwesterly and Southwesterly Types in March, it may be stated with confidence that the objective method can be applied with a considerable degree of success in all months from December to March, inclusive.

THE EASTERLY TYPE

After the test maps for December and March were typed, enough cases of the Easterly Type were at hand to permit statistical treatment. It will be recalled that the Easterly Type was defined as one in which $-M_a < -Z_c$, or $+M_a < -Z_a$. In considering this type the thought immediately occurs that, although the predominant flow over the area considered is from east to west, there must be a significant west or southwest flow in those instances in which rain ensues at San Francisco. Also occurring is the thought that with easterly flow predominating, the eastward advance of any rain-producing disturbance from the ocean should be relatively slow. Hence, the pressure at some point not too far southwest of San Francisco should give a good indication of the proximity of rain.

To test this theory the pressures at 35° N. lat., 130° W. long., and 35° N. lat., 140° W. long., were plotted in the same manner as in the case of the Southerly Type. The scatter diagram showed a rather good segregation

of rain and no rain days but did not permit the drawing of a smooth line of separation. It was then decided to plot the geographical coordinates of the most westerly low pressure center located between 20° and 50° N., and 105° and 150° W. This, too, produced good segregation, but the best line of separation appeared to be an ellipse.

Although neither of these diagrams was deemed satisfactory for use as a forecasting tool, they served the purpose of pointing the way to an acceptable one. It was noted that on one, the pressure at 35° N., 130° W., was the predominant factor in producing segregation of rain from no rain points, while on the other, the meridian of the low pressure center was the most important factor. The obvious follow-up to this was to plot these two parameters against one another. Figure 8, on which rain days are dots and no rain days are circles, shows a plot of these values for all Easterly Type maps studied. The best line of separation between rain and no rain days gives the following verification scores for forecasts made from these sample data.

TABLE 13

		FORECAST		
		Rain	No rain	Total
OBSERVED	Rain	7	2	9
	No rain	1	21	22
	Total	8	23	31

Percent correct=90
Skill score=.77

This table includes data from all four months, December, January, February, and March, and no formal test has been run on independent data. The system worked satisfactorily on several Easterly Type maps from April and May of 1947.

CONCLUSIONS

The conclusions to be drawn from this study, some of which have already been mentioned, are summarized as follows:

1. The method developed is highly objective in that two forecasters applying it to the same map will arrive at the same forecast.
2. If used during January and February for the purpose of forecasting rain or no rain during the period 24 to 48 hours after map time, the method will give forecast scores equal to or better than the scores made on official forecasts in the past for the same period.
3. If used during December and March, the method will give slightly less accurate results than in January and February, but the December and March scores will be satisfactory, especially when compared with official forecast scores of the past.
4. The method is weakest on Southerly Type maps in December and on Northwesterly and Southwesterly Type maps in March.
5. While the method is based on the study of 1200 G. C. T. maps, day-to-day tests on maps for other periods of the day indicate that with but few exceptions it is equally applicable to them.
6. Day-to-day application of the method indicates that times of the beginning of precipitation can be fairly well anticipated by comparing forecasts made by this method from successive 6-hourly maps.
7. Scrutiny of the individual maps involved in this study leads to the belief that even better results can be obtained by dividing some of the major types into subtypes and then using additional parameters for segregating "rain days" and "no rain days" therein.
8. Cursory tests on other stations within a 150-mile radius of San Francisco indicate that the same system will show considerable skill when used without modification. However, for the best results, separate scatter diagrams for each type should be constructed for each station.
9. While precipitation has not been treated quantitatively in this study, it was observed in working with the data that there was a relationship between the amount of rain recorded and the point on the scatter diagram representing the map 24 to 48 hours before the rain. This leads to the belief that, with some modifications and additions, this method will offer a promising approach to quantitative precipitation forecasting.

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in January and February, but the December and March scores will be satisfactory, especially when compared with official forecast scores of the past.

4. The method is weakest on Southerly Type maps in December and on Northwesterly and Southwesterly Type maps in March.

5. While the method is based on the study of 1230 G. C. T. maps, day-to-day tests on maps for other periods of the day indicate that with but few exceptions it is equally applicable to them.

6. Day-to-day application of the method indicates that times of the beginning of precipitation can be fairly well anticipated by comparing forecasts made by this method from successive 6-hourly maps.

7. Scrutiny of the individual maps involved in this study leads to the belief that even better results can be obtained by dividing some of the major types into subtypes and then using additional parameters for separating "rain days" and "no rain days" therein.

8. Cursory tests on other stations within a 150-mile radius of San Francisco indicate that the same system will show considerable skill when used without modification. However, for the best results, separate scatter diagrams for each type should be constructed for each station.

9. While precipitation amount has been treated quantitatively in this study, it was observed in passing with the rain that there was a relationship between the amount of rain recorded that was found on the scatter diagrams representing the case 24 to 48 hours before the rain. This leads to the belief that, with some modifications and additions, this method will offer a promising approach to quantitative precipitation forecasting.

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of rain and no rain days but did not permit the drawing of a smooth line of separation. It was then decided to plot the geographical coordinates of the most westerly low pressure center located between 20° and 50° N., and 105° and 135° W. This, too, produced good separation, but the best line of separation appeared to be an ellipse.

Although neither of these diagrams was deemed satisfactory for use as a forecasting tool, they served the purpose of pointing the way to an acceptable one. It was noted that on one, the pressure at 32° N., 135° W., was the predominant factor in producing separation of rain from no rain points, while on the other, the position of the low pressure center was the most important factor. The obvious follow-up to this was to plot these two parameters against one another. Figure 11 on which rain days are dots and no rain days are circles, shows a plot of these values for all Easterly Type maps studied. The best line of separation between rain and no rain days gives the following verification scores for forecasts made from these sample data:

TABLE 15.—[illegible]

[illegible]	[illegible]	[illegible]

The results of verification forecasts from the Easterly Type maps for January, February, and March, and the December and January of independent data. The system method [illegible] Easterly Type maps from April [illegible].

CONCLUSIONS

The conclusions to be drawn from this study, some of which have already been mentioned, are summarized as follows:

1. The method developed is equally effective in [illegible] forecasts applying it to the same map will arrive at the same forecast.

2. It made a better showing [illegible] for the [illegible] forecasting rain or no rain during the period [illegible] than the method will give [illegible] equal to or better than the average [illegible] forecasts in the past for the same period.

3. It [illegible] December and March; the method [illegible] slightly less [illegible].

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR NOVEMBER 1947

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during November 1947*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,006.4 mb.)				Albuquerque, N. Mex. (836.1 mb.)				Apalachicola, Fla. (1,015.8 mb.)				Atlanta, Ga. (982.2 mb.)				Auburn, Calif. (959.3 mb.)				Big Spring, Tex. (927.0 mb.)				Bismarck, N. Dak. (956.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	86	1.5	77	30	1,620	5.9	40	30	5	16.2	85	30	300	8.7	82	30	501	9.0	63	30	774	9.6	60	30	505	-4.9	82
1,000	30	138	(*)		30	126	(*)		30	138	16.6	79	30	150	(*)		30	154	(*)		30	135	(*)		30	147	(*)	
950	30	555	.7	69	30	563	(*)		30	580	15.5	71	30	580	9.2	72	30	585	10.6	56	30	571	(*)		30	556	(*)	
900	30	983	-1.8	71	30	1,016	(*)		30	1,032	14.0	62	30	1,024	8.4	69	30	1,032	9.1	43	30	1,019	10.1	56	30	978	-6.1	79
850	30	1,436	-3.6	70	30	1,484	(*)		30	1,513	12.1	54	30	1,496	7.5	55	30	1,504	6.8	42	30	1,493	8.7	50	30	1,425	-7.4	77
800	30	1,914	-4.7	67	30	1,980	4.4	40	30	2,019	10.2	45	30	1,993	5.7	51	30	1,999	3.7	43	30	1,993	6.4	47	30	1,896	-8.5	71
750	30	2,427	-6.6	62	30	2,510	.9	44	30	2,565	7.9	46	30	2,526	3.7	44	30	2,521	.7	44	30	2,525	3.8	44	30	2,399	-9.8	64
700	30	2,957	-9.0	63	30	3,053	-2.6	48	30	3,121	5.2	46	30	3,077	1.1	43	29	3,070	-2.5	39	30	3,077	.5	40	30	2,925	-12.1	61
650	29	3,533	-11.9	55	30	3,641	-6.3	51	30	3,727	1.8	46	30	3,674	-1.8	40	29	3,652	-5.8	37	30	3,672	-2.3	36	30	3,492	-14.8	55
600	29	4,137	-15.1	48	30	4,259	-10.0	46	29	4,365	-2.0	45	30	4,303	-5.1		29	4,277	-9.5	37	30	4,300	-5.7		30	4,092	-17.9	52
550	28	4,798	-19.0		30	4,928	-13.6	40	29	5,050	-6.0	43	29	4,985	-8.7		29	4,941	-13.4	41	30	4,976	-9.8		30	4,737	-22.0	
500	27	5,498	-23.5		30	5,644	-18.0	43	29	5,791	-10.5	49	29	5,714	-13.3		29	5,663	-18.3	41	29	5,706	-14.4		30	5,432	-26.2	
450	27	6,267	-28.3		30	6,430	-23.3		29	6,602	-15.3	54	29	6,515	-18.4		27	6,439	-24.3		29	6,504	-20.0		30	6,186	-31.5	
400	27	7,096	-33.5		29	7,268	-29.4		29	7,425	-21.2		29	7,378	-24.2		27	7,284	-30.5		29	7,360	-26.2		30	7,009	-37.4	
350	25	8,027	-38.9		29	8,207	-36.1		29	8,446	-28.1		29	8,338	-30.8		25	8,231	-36.7		29	8,312	-32.9		30	7,918	-43.9	
300	24	9,067	-45.2		28	9,266	-43.1		29	9,534	-36.2		29	9,414	-38.5		25	9,280	-44.7		28	9,377	-39.8		30	8,937	-50.5	
250	23	10,262	-50.1		22	10,492	-49.7		29	10,773	-45.6		28	10,645	-47.5		25	10,475	-53.2		28	10,603	-47.2		25	10,143	-53.5	
200	16	11,720	-52.6		12	11,965	-54.2		27	12,226	-56.1		27	12,086	-55.9		22	11,896	-58.3		27	12,052	-54.4		18	11,583	-52.8	
175	9	12,552	-53.0		6	12,853	-55.8		24	13,063	-61.2		22	12,916	-59.2		19	12,744	-59.8		23	12,912	-56.7		13	12,459	-52.5	
150	5	13,557	-55.3						21	14,009	-65.0		10	13,825	-59.9		13	13,725	-59.9		14	13,904	-60.6		11	13,481	-53.7	
125									15	15,107	-67.8										5	15,043	-65.3					
100									5	16,456	-72.5																	

Standard pressure surface (mb.)	Boise, Idaho (919.0 mb.)				Brownsville, Tex. (1,013.1 mb.)				Buffalo, N. Y. (990.3 mb.)				Caribou, Maine (992.0 mb.)				Charleston, S. C. (1,015.1 mb.)				Ciudad Victoria, Mexico (974.7 mb.)				Columbia, Mo. (987.7 mb.)			
Surface	30	868	2.4	81	30	6	20.2	81	29	221	3.1	72	30	191	-1.4	86	30	13	11.2	89	29	335	21.4	64	30	239	4.1	74
1,000	30	178	(*)		30	118	20.8	77	29	141	(*)		30	127	(*)		30	138	12.6	82	29	111	(*)		30	137	(*)	
950	30	600	(*)		30	566	18.9	74	29	559	1.7	68	30	540	-1.4	81	30	575	12.3	75	29	562	20.7	60	30	557	3.0	75
900	30	1,037	3.3	75	30	1,025	16.7	68	29	990	-.7	72	30	965	-3.3	76	30	1,022	10.9	69	29	1,022	17.5	64	30	991	1.6	69
850	30	1,499	1.0	73	30	1,511	14.6	57	29	1,444	-3.3	73	30	1,416	-4.7	68	30	1,498	9.3	58	29	1,509	14.5	68	30	1,451	.4	68
800	30	1,984	-1.9	77	30	2,022	12.6	52	29	1,922	-5.2	73	30	1,892	-5.9	65	30	1,999	7.7	47	29	2,019	12.3	68	30	1,936	-1.0	65
750	30	2,501	-4.6	75	30	2,567	10.4	46	29	2,437	-7.0	62	30	2,401	-7.5	64	30	2,535	5.6	43	29	2,564	10.6	59	30	2,454	-3.5	68
700	30	3,035	-7.6	72	30	3,134	7.3	43	29	2,963	-9.2	55	30	2,932	-9.4	58	29	3,090	2.6	43	29	3,132	7.2	51	30	2,992	-6.2	70
650	30	3,610	-10.7	70	29	3,743	3.3	42	29	3,539	-12.0	52	30	3,509	-12.1	61	29	3,689	-.4		29	3,740	3.2	52	29	3,570	-9.5	62
600	30	4,221	-14.1	64	29	4,385	-.5	37	27	4,150	-15.1	42	29	4,114	-15.2	59	28	4,324	-3.9		29	4,383	-.7	48	29	4,179	-12.8	49
550	30	4,875	-18.3	61	29	5,075	-4.7	36	27	4,808	-19.1		29	4,769	-19.1	60	26	5,010	-7.3		29	5,072	-4.8	44	29	4,841	-16.6	
500	30	5,580	-23.1		29	5,818	-9.6		25	5,514	-23.6		28	5,470	-23.4		26	5,744	-11.8		29	5,815	-9.6	45	29	5,547	-21.3	
450	30	6,348	-28.8		29	6,632	-15.3		25	6,290	-28.5		28	6,239	-28.4		26	6,551	-16.9		29	6,628	-14.9	44	28	6,323	-26.6	
400	30	7,176	-34.5		28	7,504	-21.2		25	7,112	-34.2		28	7,069	-34.0		26	7,420	-22.6		29	7,504	-20.5		28	7,156	-32.5	
350	30	8,095	-41.2		28	8,477	-27.8		24	8,048	-40.1		28	7,991	-40.6		26	8,386	-29.5		29	8,477	-27.8		26	8,092	-38.6	
300	29	9,130	-47.8		28	9,566	-35.8		24	9,086	-46.4		26	9,011	-47.6		26	9,469	-37.2		29	9,566	-36.2		24	9,144	-44.6	
250	25	10,291	-53.6		27	10,808	-45.0		22	10,288	-51.4		21	10,192	-52.6		25	10,710	-46.5		29	10,805	-46.2		22	10,344	-50.2	
200	16	11,754	-55.4		27	12,266	-54.7		15	11,748	-54.8		6	11,596	-53.1		23	12,157	-56.6		25	12,255	-57.1		17	11,769	-52.7	
175	8	12,556	-55.8		25	13,115	-60.0		8	12,582	-54.0						18	12,997	-61.7		19	13,088	-62.8		14	12,628	-53.6	
150					21	14,073	-64.6										9	13,965	-64.5		6	14,063	-67.2		10	13,598	-55.7	
125					5	15,208	-67.8																		6	14,731	-58.8	

Standard pressure surface (mb.)	Dodge City, Kans. (924.2 mb.)				El Paso, Tex. (881.1 mb.)				Ely, Nev. (808.7 mb.)				Fort Worth, Tex. (992.0 mb.)				Glasgow, Mont. (940.2 mb.)				Grand Junction, Colo. (851.7 mb.)				Great Falls, Mont. (886.0 mb.)			
Surface	30	787	3.1	72	30	1,195	10.4	43	30	1,908	-1.6	70	30	211	10.5	68	29	648	-3.4	74	29	1,474	1.1	68	30	1,128	-0.7	73
1,000	30	141	(*)		30	120	(*)		30	175	(*)		30	144	(*)		29	154	(*)		29	158	(*)		30	149	(*)	
950	30	565	(*)		30	557	(*)		30	604	(*)		30	577	10.3	61	29	566	(*)		29	589	(*)		30	573	(*)	
900	30	1,002	4.5	66	30	1,018	(*)		30	1,042	(*)		30	1,021	8.7	58	29	993	-3.6	73	29	1,026	(*)		30	1,009	(*)	
850	30	1,466	2.4	65	30	1,491	10.0	40	30	1,505	(*)		30	1,493	7.1	57	29	1,443	-5.5	76	29	1,490	(*)		30	1,460	-.9	67
800	30	1,955	.7	61	30	1,991	7.0	41	30	1,994	-.5	69	30	1,989	4.7	54	29	1,917	-7.3	76	29	1,977	-.1	63	30	1,941	-3.5	66
750	30	2,475	-2.0	57	30	2,525	3.7	41	30	2,511	-2.9	66	30	2,517	2.5	49	29	2,424	-8.9	67	28	2,490	-3.6	65	30	2,451	-6.6	71
700	30	3,016	-4.7	53	30	3,075	.3	39	30	3,051	-6.4	67	30	3,069	.1	43	29	2,950	-11.5	64	28	3,028	-7.3	73	30	2,985	-9.9	73
650	30	3,601	-8.2	53	30	3,669	-3.2	36	30	3,631	-9.7	68	30	3,664	-2.9	34	29	3,520	-14.2	64	27	3,600	-11.4	76	30	3,557	-13.3	73
600	30	4,213	-11.8	49	30	4,295	-6.9	34	30	4,241	-12.8	61	30	4,290	-6.4		29	4,118	-18.0	66	27	4,205	-15.3	77	30	4,158	-17.1	71
550	30	4,878	-15.6	45	30	4,969	-11.5		30	4,900	-16.6	51	30	4,967	-10.8		29	4,763	-22.1		26	4,862	-19.1	70	30	4,807	-21.0	
500	30	5,586	-20.2	45	30	5,692	-16.3		30	5,610	-21.4		30	5,692	-15.7		29	5,457	-26.8		26	5,564	-23.2		30	5,502	-26.0	
450	30	6,360	-25.7		30	6,480	-22.0		30	6,382	-26.9		30	6,485	-21.4		29	6,213	-31.8		26	6,335	-28.3		30	6,261	-31.2	
400	30	7,201	-32.0		30	7,331	-28.4		30	7,217	-32.8		30	7,337	-27.5		29	7,033	-37.6		25	7,167	-34.3		30	7,082	-37.4	
350	29	8,142	-38.0		30	8,275	-35.1		30	8,145	-39.1		30	8,285	-33.7		29	7,941	-43.6		25	8,087	-41.3		30	7,991	-43.5	
300	29	9,187	-45.1		29	9,337	-42.4		29	9,193	-46.0		30	9,351	-40.7		29	8,964	-49.3		25	9,118	-48.0		30	9,013	-49.5	
250	24	10,386	-50.8		25	10,540	-50.2		25	10,398	-51.9		29	10,572	-48.6		29	10,147	-53.0		22	10,294	-52.6		25	10,206	-53.6	
200	21	11,838	-54.2		21	11,978	-56.6		19	11,817	-56.1		25	12,012	-55.8		22	11,598	-52.9		20	11,724	-54.6		16	11,638	-53.7	
175	16	12,686	-55.7		14	12,847	-59.3		13	12,693	-56.9		18	12,863	-59.2		16	12,445	-52.3		16	12,584	-55.1		10	12,522	-54.5	
150	11	13,670	-58.0		10	13,826	-62.7		6	13,784	-60.2		12	13,803	-62.0		10	13,431	-52.3		11	13,549	-56.8					
125	5	14,781	-57.7		5	14,921	-65.3														6	14,740	-59.9					

See footnotes at end of table.

Table 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during November 1947*—Continued

Standard pressure surface (mb.)	Greensboro, N. C. (985.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Hatteras, N. C. (1,016.3 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Havana, Cuba[1] (.... mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Honolulu, T. H. (1,013.1 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Huntington, W. Va. (997.5 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	International Falls, Minn. (973.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Joliet, Ill. (995.1 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	273	6.1	81	30	3	13.8	75	----	------	------	----	30	3	25.8	72	30	172	5.4	79	30	360	-6.0	86	30	78	1.0	80
1,000	30	153	(*)	----	30	138	13.5	69	----	------	------	----	30	118	24.7	72	30	151	(*)	----	30	149	(*)	----	30	138	(*)	----
950	30	579	7.4	67	30	572	11.1	65	----	------	------	----	30	570	21.3	78	30	573	4.5	73	30	550	-5.8	85	30	553	-.5	77
900	30	1,020	5.7	69	30	1,019	8.7	61	----	------	------	----	30	1,034	18.0	81	30	1,009	1.8	75	30	974	-8.1	85	30	981	-1.8	75
850	30	1,486	3.6	70	30	1,490	6.3	59	----	------	------	----	30	1,522	15.1	79	30	1,468	-.2	77	30	1,417	-9.3	80	30	1,434	-3.2	71
800	30	1,976	2.3	59	30	1,986	4.8	53	----	------	------	----	30	2,034	12.9	63	30	1,953	-1.8	76	30	1,884	-11.3	72	30	1,914	-4.4	65
750	30	2,501	.2	54	30	2,518	3.3	43	----	------	------	----	30	2,584	10.6	51	30	2,472	-3.1	66	30	2,382	-12.5	68	30	2,426	-6.2	59
700	30	3,048	-1.6	48	30	3,068	1.1	41	----	------	------	----	30	3,147	7.6	44	30	3,010	-5.1	59	30	2,903	-14.3	63	30	2,958	-8.7	61
650	29	3,636	-4.5	38	30	3,664	-1.6	----	----	------	------	----	30	3,759	4.8	38	30	3,595	-7.8	52	30	3,466	-16.3	60	30	3,539	-11.4	57
600	29	4,260	-7.9	38	30	4,293	-5.2	----	----	------	------	----	30	4,403	1.6	34	30	4,209	-11.0	48	30	4,060	-19.4	57	30	4,140	-14.4	53
550	29	4,935	-11.5	----	30	4,976	-9.2	----	----	------	------	----	30	5,100	-2.6	33	30	4,875	-15.0	45	30	4,701	-23.4	----	29	4,800	-18.5	51
500	29	5,656	-16.4	----	30	5,702	-13.6	----	----	------	------	----	30	5,848	-7.2	30	30	5,587	-19.7	50	30	5,394	-27.4	----	28	5,496	-22.9	----
450	29	6,450	-21.9	----	30	6,508	-18.5	----	----	------	------	----	30	6,674	-12.4	----	30	6,366	-24.9	----	30	6,149	-32.7	----	28	6,267	-28.4	----
400	29	7,298	-27.2	----	30	7,364	-24.3	----	----	------	------	----	28	7,548	-18.9	----	29	7,213	-29.9	----	29	6,968	-38.6	----	28	7,094	-34.4	----
350	29	8,247	-33.2	----	30	8,324	-30.9	----	----	------	------	----	28	8,527	-26.2	----	29	8,151	-36.2	----	29	7,872	-44.7	----	28	8,017	-40.0	----
300	29	9,314	-40.3	----	29	9,397	-38.3	----	----	------	------	----	28	9,623	-34.9	----	29	9,206	-42.8	----	28	8,889	-49.6	----	27	9,056	-45.3	----
250	29	10,535	-48.3	----	24	10,634	-46.8	----	----	------	------	----	27	10,873	-43.4	----	28	10,426	-49.0	----	27	10,083	-52.1	----	25	10,264	-49.3	----
200	25	11,963	-56.0	----	20	12,077	-55.0	----	----	------	------	----	25	12,346	-52.0	----	25	11,865	-55.4	----	23	11,536	-51.8	----	18	11,703	-50.2	----
175	21	12,824	-59.1	----	9	12,926	-57.2	----	----	------	------	----	22	13,204	-56.5	----	21	12,725	-57.4	----	15	12,413	-52.1	----	12	12,592	-51.2	----
150	15	13,781	-61.0	----	----	------	------	----	----	------	------	----	19	14,171	-61.2	----	17	13,697	-59.7	----	6	13,378	-52.9	----	7	13,563	-53.4	----
125	6	14,862	-63.0	----	----	------	------	----	----	------	------	----	12	15,274	-66.6	----	9	14,828	-62.4	----	5	14,523	-53.7	----	----	------	------	----

Standard pressure surface (mb.)	Lake Charles, La. (1,015.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Lander, Wyo. (826.9 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Las Vegas, Nev. (948.9 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Little Rock, Ark. (1,007.1 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Mazatlan, Mexico (1,009.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Medford, Oreg. (974.2 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Merida, Mexico (1,009.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	5	13.8	82	30	1,696	-3.6	78	30	574	10.4	40	30	79	8.8	80	30	14	24.6	69	30	401	6.7	87	30	27	26.0	81
1,000	30	135	14.9	73	30	163	(*)	----	30	132	(*)	----	30	137	(*)	----	30	98	24.1	65	30	185	(*)	----	30	111	25.6	80
950	30	574	12.8	70	30	583	(*)	----	30	567	(*)	----	30	567	8.7	66	30	548	22.6	45	30	613	7.0	80	30	564	22.9	79
900	30	1,023	12.3	58	30	1,020	(*)	----	30	1,017	11.1	32	30	1,009	7.4	62	30	1,015	20.0	44	30	1,051	5.3	77	30	1,033	19.6	80
850	30	1,501	10.6	52	30	1,476	(*)	----	30	1,491	7.4	36	30	1,478	5.3	58	30	1,505	16.5	47	30	1,516	2.5	77	30	1,524	17.0	74
800	30	2,004	8.1	54	30	1,958	-2.0	68	30	1,986	3.9	40	30	1,972	2.9	58	30	2,017	13.0	47	30	2,004	-.2	79	30	2,040	14.6	63
750	30	2,542	5.8	52	30	2,473	-4.3	63	30	2,513	.3	44	30	2,500	.8	56	30	2,562	9.3	48	30	2,522	-2.7	73	30	2,588	11.9	55
700	30	3,097	3.4	45	30	3,010	-7.2	64	30	3,057	-3.5	50	30	3,045	-1.4	53	30	3,126	5.7	42	30	3,064	-5.0	64	30	3,158	8.9	46
650	30	3,699	.1	44	30	3,590	-10.9	68	30	3,643	-6.9	53	29	3,634	-4.2	49	30	3,730	2.5	----	30	3,646	-8.0	50	30	3,768	5.3	45
600	30	4,333	-3.5	41	30	4,195	-15.0	71	30	4,260	-10.4	51	29	4,257	-7.5	----	30	4,371	-1.3	----	30	4,261	-11.4	47	29	4,417	1.3	43
550	30	5,016	-7.6	----	30	4,851	-19.5	71	30	4,925	-14.6	52	29	4,933	-11.4	----	29	5,060	-5.2	----	30	4,922	-15.3	45	29	5,111	-2.6	35
500	30	5,751	-12.2	----	30	5,548	-24.4	----	30	5,641	-19.4	50	29	5,654	-16.0	----	28	5,799	-10.1	----	30	5,637	-18.9	50	29	5,861	-7.6	37
450	30	6,558	-17.5	----	30	6,310	-29.7	----	30	6,422	-24.9	----	29	6,451	-21.0	----	28	6,614	-15.4	----	30	6,413	-25.3	----	29	6,681	-12.7	----
400	30	7,423	-23.4	----	29	7,138	-35.6	----	30	7,263	-30.9	----	29	7,301	-26.8	----	28	7,486	-21.4	----	30	7,256	-31.3	----	29	7,563	-18.4	----
350	30	8,387	-30.5	----	28	8,060	-42.3	----	30	8,197	-37.4	----	29	8,253	-33.2	----	28	8,455	-28.6	----	30	8,188	-38.2	----	27	8,541	-26.1	----
300	30	9,466	-38.0	----	28	9,086	-49.2	----	30	9,245	-44.7	----	26	9,312	-40.6	----	28	9,541	-36.7	----	30	9,230	-46.0	----	26	9,636	-34.8	----
250	28	10,697	-46.9	----	28	10,266	-54.0	----	28	10,454	-51.5	----	25	10,532	-48.2	----	24	10,778	-45.9	----	30	10,419	-54.4	----	24	10,890	-44.9	----
200	28	12,144	-56.2	----	26	11,690	-54.5	----	26	11,883	-56.2	----	11	11,988	-54.8	----	16	12,219	-57.0	----	23	11,852	-58.5	----	14	12,354	-56.5	----
175	27	12,984	-60.3	----	23	12,537	-55.1	----	23	12,743	-58.4	----	----	------	------	----	13	13,055	-62.5	----	17	12,702	-59.4	----	8	13,202	-62.7	----
150	17	13,937	-63.7	----	15	13,528	-55.8	----	21	13,701	-59.4	----	----	------	------	----	8	14,022	-68.0	----	13	13,660	-60.7	----	----	------	------	----
125	10	15,041	-65.0	----	6	14,598	-54.8	----	9	14,746	-58.1	----	----	------	------	----	----	------	------	----	----	------	------	----	----	------	------	----

Standard pressure surface (mb.)	Miami, Fla. (1,014.8 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Nantucket, Mass. (1,014.0 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Nashville, Tenn. (995.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	New Orleans, La. (1,015.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	North Platte, Nebr. (916.7 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Oakland, Calif. (1,018.2 mb.) Number of observations	Dynamic height	Temperature	Relative humidity	Ogden, Utah (865.6 mb.) Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	4	23.1	83	30	14	5.9	73	30	180	8.4	75	30	2	15.2	84	30	849	0.1	81	30	6	11.6	72	30	1,355	1.3	76
1,000	30	132	23.1	81	30	127	5.2	70	30	144	(*)	----	30	134	15.8	76	30	143	(*)	----	30	157	12.0	65	30	174	(*)	----
950	30	583	20.5	81	30	545	2.2	74	30	566	6.9	74	30	575	13.9	73	30	563	(*)	----	30	592	10.8	52	30	601	(*)	----
900	30	1,045	17.8	78	30	980	.5	72	30	1,009	5.0	73	30	1,025	12.7	64	30	997	.9	76	30	1,035	9.0	45	30	1,040	(*)	----
850	30	1,533	15.5	72	30	1,438	-.7	58	30	1,475	3.5	71	29	1,503	11.0	53	30	1,454	-1.3	72	30	1,507	7.2	40	30	1,501	1.1	73
800	30	2,046	13.1	64	30	1,921	-2.2	55	30	1,966	1.6	63	29	2,007	9.2	48	30	1,936	-3.3	69	30	2,003	4.8	33	30	1,986	-1.9	72
750	30	2,592	10.7	57	30	2,434	-4.3	50	30	2,490	-.3	56	28	2,545	7.0	49	30	2,451	-5.3	62	30	2,536	2.4	27	30	2,501	-5.2	78
700	30	3,160	7.8	54	30	2,973	-6.4	50	30	3,034	-2.8	51	28	3,104	4.5	44	30	2,984	-8.1	57	30	3,082	-.2	----	30	3,036	-8.3	78
650	30	3,768	4.4	49	30	3,554	-9.1	47	30	3,621	-5.7	47	28	3,709	1.1	49	30	3,562	-11.6	55	30	3,677	-3.4	----	30	3,614	-11.7	78
600	29	4,416	.7	43	28	4,163	-12.6	50	30	4,242	-8.7	48	28	4,344	-2.6	50	30	4,164	-15.1	53	30	4,300	-7.0	----	30	4,216	-15.2	72
550	29	5,109	-3.2	38	28	4,824	-16.0	----	30	4,914	-12.6	46	28	5,030	-6.7	48	30	4,821	-18.9	52	30	4,976	-11.2	----	30	4,873	-18.9	63
500	29	5,858	-7.8	42	28	5,534	-20.6	----	29	5,633	-16.9	----	28	5,767	-11.2	49	29	5,521	-23.8	----	29	5,705	-15.7	----	30	5,573	-23.5	----
450	29	6,674	-13.3	44	28	6,308	-25.7	----	28	6,422	-21.7	----	26	6,573	-16.5	51	29	6,290	-29.2	----	29	6,498	-21.2	----	30	6,343	-29.0	----
400	28	7,557	-19.2	48	28	7,150	-31.4	----	27	7,274	-27.0	----	26	7,442	-22.4	----	29	7,114	-35.0	----	29	7,350	-27.4	----	30	7,167	-35.4	----
350	27	8,537	-26.0	----	24	8,103	-36.9	----	27	8,224	-33.2	----	26	8,409	-29.2	----	29	8,032	-41.3	----	29	8,297	-34.7	----	30	8,083	-42.0	----
300	27	9,663	-34.3	----	22	9,153	-43.3	----	27	9,292	-40.4	----	26	9,492	-37.1	----	29	9,062	-47.7	----	29	9,356	-42.8	----	30	9,111	-48.7	----
250	26	10,883	-44.3	----	18	10,359	-49.5	----	25	10,503	-48.2	----	26	10,729	-45.9	----	27	10,238	-52.4	----	26	10,585	-50.9	----	30	10,295	-53.4	----
200	25	12,343	-55.9	----	----	------	------	----	18	11,933	-53.7	----	25	12,178	-55.6	----	27	11,675	-53.4	----	21	12,006	-58.0	----	28	11,730	-54.6	----
175	18	13,182	-61.8	----	----	------	------	----	13	12,773	-56.2	----	22	13,019	-60.4	----	22	12,531	-54.3	----	13	12,901	-59.2	----	23	12,618	-55.3	----
150	10	14,125	-67.3	----	----	------	------	----	11	13,738	-58.3	----	17	13,962	-63.4	----	17	13,540	-55.7	----	5	13,926	-60.0	----	17	13,604	-57.6	----
125	----	------	------	----	----	------	------	----	7	14,879	-60.2	----	12	15,082	-65.7	----	----	------	------	----	----	------	------	----	12	14,732	-59.2	----
100	----	------	------	----	----	------	------	----	----	------	------	----	6	16,445	-68.2	----	----	------	------	----	----	------	------	----	----	------	------	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during November 1947*—Continued

Standard pressure surface (mb.)	Oklahoma City, Okla. (970.2 mb.)				Omaha, Nebr. (979.7 mb.)				Phoenix, Ariz. (974.2 mb.)				Pittsburgh, Pa. (971.5 mb.)				Portland, Maine (1,013.2 mb.)				Rapid City, S. Dak. (902.2 mb.)				St. Cloud, Minn. (977.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	391	7.1	72	30	308	2.8	78	29	339	13.0	54	30	382	3.9	71	30	20	1.2	76	30	980	−3.3	76	30	317	−3.7	88
1,000	30	140	(*)	----	30	140	(*)	----	29	117	(*)	----	30	145	(*)	----	30	125	2.2	69	30	153	(*)	----	30	132	(*)	----
950	30	565	7.8	65	30	559	.6	81	29	556	15.9	41	30	568	3.2	69	30	542	.4	66	30	567	(*)	----	30	544	−4.0	87
900	30	1,009	6.0	64	30	988	−1.1	80	29	1,009	12.8	41	30	1,000	.5	72	30	970	−1.6	66	30	999	(*)	----	30	963	−5.5	86
850	30	1,475	4.4	61	30	1,443	−2.4	81	29	1,486	9.0	46	30	1,457	−1.5	68	30	1,424	−2.8	58	30	1,454	−2.4	68	30	1,410	−7.1	84
800	30	1,968	2.9	57	30	1,923	−4.1	78	29	1,984	5.2	48	30	1,938	−3.3	65	30	1,904	−4.1	53	30	1,934	−4.5	65	30	1,881	−8.3	78
750	30	2,494	.3	56	30	2,434	−6.4	75	29	2,516	1.7	49	30	2,454	−4.9	58	30	2,417	−5.9	49	30	2,442	−6.8	64	30	2,389	−9.7	69
700	30	3,039	−2.4	53	30	2,967	−9.1	71	29	3,061	−1.4	42	29	2,988	−6.8	53	30	2,948	−8.4	46	30	2,977	−9.1	60	30	2,911	−11.9	63
650	30	3,626	−5.6	48	30	3,545	−12.0	67	29	3,656	−4.0	41	29	3,575	−9.4	50	29	3,531	−11.1	----	30	3,553	−12.0	58	30	3,481	−14.4	59
600	30	4,248	−9.3	42	30	4,147	−15.4	61	29	4,275	−8.1	40	29	4,179	−12.9	51	29	4,136	−14.7	----	30	4,156	−15.3	58	30	4,080	−17.5	57
550	30	4,917	−13.2	----	29	4,807	−19.3	60	29	4,948	−12.1	37	29	4,840	−16.9	46	28	4,791	−18.5	----	30	4,811	−19.3	58	29	4,733	−21.0	----
500	30	5,635	−18.1	----	29	5,505	−24.1	----	29	5,668	−17.3	41	29	5,546	−21.1	----	28	5,493	−23.0	----	30	5,511	−23.9	----	29	5,429	−25.3	----
450	29	6,417	−23.5	----	29	6,273	−29.4	----	29	6,459	−22.8	----	29	6,325	−26.2	----	28	6,261	−28.3	----	30	6,278	−29.3	----	28	6,198	−30.7	----
400	28	7,261	−29.6	----	29	7,098	−35.0	----	29	7,304	−29.3	----	29	7,159	−31.9	----	28	7,093	−33.6	----	30	7,104	−35.3	----	28	7,018	−36.4	----
350	27	8,197	−35.6	----	29	8,017	−40.9	----	29	8,243	−36.3	----	29	8,090	−38.0	----	28	8,019	−39.1	----	27	8,028	−41.9	----	26	7,943	−42.2	----
300	22	9,266	−42.1	----	28	9,053	−47.2	----	29	9,295	−44.1	----	28	9,149	−43.6	----	27	9,066	−45.5	----	25	9,062	−48.3	----	25	8,968	−47.8	----
250	18	10,472	−48.0	----	27	10,245	−52.0	----	27	10,506	−51.5	----	28	10,357	−49.2	----	25	10,258	−50.9	----	24	10,248	−52.8	----	23	10,160	−51.6	----
200	9	11,928	−51.9	----	22	11,668	−52.8	----	19	11,978	−56.5	----	24	11,822	−54.0	----	18	11.713	−54.1	----	22	11,692	−52.6	----	15	11,633	−51.9	----
175	5	12,819	−54.6	----	16	12,532	−53.5	----	13	12,818	−57.5	----	20	12,678	−56.0	----	14	12,534	−54.0	----	21	12,557	−53.1	----	10	12,489	−52.9	----
150	----	----	----	----	12	13,488	−54.7	----	10	13,774	−59.8	----	13	13,669	−58.2	----	9	13,501	−55.3	----	10	13,544	−53.2	----	----	----	----	----

Standard pressure surface (mb.)	San Antonio, Tex. (987.3 mb.)				San Juan, P. R. (1,012.7 mb.)				Santa Maria, Calif. (1,009.0 mb.)				Sault Ste. Marie, Mich. (987.9 mb.)				Spokane, Wash. (948.0 mb.)				Swan Island, W. I. (1,011.6 mb.)				Tacubaya, Mexico (773.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	240	13.5	70	30	15	25.8	78	30	71	10.6	74	30	221	−0.1	78	30	598	2.1	86	30	10	26.5	83	29	2,306	15.1	60
1,000	30	131	(*)	----	30	126	25.0	79	30	147	10.9	69	30	123	(*)	----	30	164	(*)	----	30	112	26.0	83	29	66	(*)	----
950	30	570	14.3	63	30	580	21.8	84	30	581	11.6	50	30	538	−1.4	76	30	583	(*)	----	30	570	22.7	83	29	527	(*)	----
900	30	1,021	13.2	62	30	1,045	18.5	85	30	1,025	10.1	42	30	962	−3.8	76	30	1,016	.7	84	30	1,033	20.0	76	29	1,001	(*)	----
850	30	1,500	10.9	59	30	1,535	15.6	81	30	1,498	7.8	37	30	1,412	−6.2	79	30	1,473	−1.6	79	30	1,525	17.2	73	29	1,496	(*)	----
800	30	2,004	8.7	53	30	2,048	13.5	65	30	1,996	5.6	33	30	1,884	−8.7	80	30	1,953	−4.2	81	30	2,041	14.4	67	29	2,023	(*)	----
750	30	2,541	6.8	41	30	2,595	11.8	46	30	2,529	3.3	----	30	2,388	−11.1	75	30	2,468	−6.8	80	30	2,591	11.7	56	29	2,572	13.8	58
700	30	3,100	4.1	37	30	3,165	9.1	35	30	3,078	1.0	----	30	2,911	−13.0	65	30	2,996	−9.4	76	29	3,159	8.4	51	29	3,148	9.5	63
650	30	3,702	.6	34	30	3,778	5.9	31	30	3,675	−2.1	----	30	3,479	−15.6	62	30	3,571	−12.5	73	29	3,771	4.8	52	29	3,761	4.8	71
600	30	4,338	−3.0	----	30	4,427	2.3	29	29	4,299	−6.1	----	30	4,073	−18.8	61	30	4,172	−16.2	72	28	4,416	.8	46	29	4,407	.3	71
550	29	5,022	−7.3	----	30	5,125	−1.7	----	29	4,976	−10.3	----	30	4,720	−22.0	----	30	4,825	−20.2	69	28	5,111	−3.5	46	29	5,101	−4.0	66
500	29	5,755	−12.2	----	30	5,876	−6.4	----	29	5,701	−15.3	----	30	5,413	−26.3	----	30	5,521	−25.0	----	28	5,857	−7.9	47	29	5,847	−8.3	56
450	28	6,566	−17.5	----	30	6,701	−11.6	----	29	6,494	−21.0	----	29	6,177	−31.5	----	30	6,284	−30.1	----	28	6,678	−12.8	48	29	6,665	−13.3	46
400	28	7,423	−23.3	----	30	7,584	−17.6	----	29	7,347	−27.5	----	28	6,992	−36.9	----	30	7,108	−36.2	----	27	7,561	−18.3	50	28	7,546	−19.0	43
350	28	8,387	−30.0	----	30	8,568	−25.1	----	27	8,293	−34.7	----	27	7,913	−42.5	----	30	8,022	−42.4	----	27	8,544	−25.2	----	28	8,526	−26.2	----
300	24	9,463	−37.7	----	30	9,669	−33.6	----	23	9,352	−42.8	----	18	8,919	−47.7	----	28	9,054	−48.6	----	27	9,644	−33.6	----	28	9,610	−35.1	----
250	22	10,692	−45.8	----	28	10,920	−43.6	----	7	10,563	−50.8	----	----	----	----	----	24	10,238	−53.1	----	27	10,896	−43.7	----	22	10,867	−45.1	----
200	19	12,139	−55.3	----	28	12,383	−54.7	----	----	----	----	----	----	----	----	----	17	11,646	−53.5	----	26	12,357	−55.7	----	----	----	----	----
175	16	12,982	−58.9	----	27	13,226	−60.8	----	----	----	----	----	----	----	----	----	14	12,498	−54.2	----	25	13,195	−62.3	----	----	----	----	----
150	11	13,941	−61.3	----	13	14,467	−67.4	----	----	----	----	----	----	----	----	----	6	13,580	−55.4	----	20	14,128	−69.4	----	----	----	----	----
125	7	15,064	−63.9	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during November 1947*—Continued

Standard pressure surface (mb.)	Tampa, Fla. (1,015.2 mb.)				Tatoosh Island, Wash. (1,016.4 mb.)				Toledo, Ohio (993.6 mb.)				Washington, D. C. (1,015.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	9	19.2	86	30	31	7.7	86	30	191	2.7	81	30	25	7.5	67
1,000	30	138	19.3	83	30	165	7.5	82	30	137	(*)	----	30	152	7.1	64
950	30	584	17.5	76	30	590	5.4	77	30	556	1.1	78	30	574	4.8	65
900	30	1,040	15.4	74	30	1,027	3.1	76	30	985	−1.5	77	30	1,011	2.4	67
850	30	1,524	13.5	67	30	1,488	1.1	74	30	1,440	−2.8	69	30	1,472	1.0	58
800	30	2,033	11.1	58	30	1,974	−1.3	70	30	1,919	−4.5	61	30	1,958	−1.5	61
750	30	2,578	8.4	59	30	2,492	−3.7	61	30	2,431	−6.2	58	30	2,476	−3.2	55
700	30	3,137	5.7	55	30	3,029	−6.5	57	30	2,964	−8.3	55	30	3,015	−5.1	50
650	30	3,744	2.5	50	30	3,609	−9.9	55	30	3,542	−11.2	56	30	3,599	−7.3	45
600	29	4,387	−1.0	47	30	4,219	−13.3	53	29	4,145	−14.3	51	30	4,216	−10.3	39
550	29	5,078	−4.8	49	30	4,879	−17.0	58	29	4,801	−18.3	49	30	4,883	−14.1	38
500	29	5,820	−9.3	46	30	5,586	−21.5	----	29	5,505	−22.4	----	29	5,595	−18.8	40
450	29	6,634	−14.1	49	30	6,363	−26.6	----	29	6,274	−27.5	----	29	6,374	−24.0	----
400	28	7,512	−20.1	53	30	7,196	−32.4	----	29	7,109	−33.6	----	29	7,221	−30.2	----
350	28	8,488	−26.9	----	30	8,124	−38.8	----	29	8,033	−39.7	----	29	8,159	−36.2	----
300	28	9,580	−35.1	----	30	9,167	−45.8	----	27	9,069	−45.8	----	29	9,215	−42.3	----
250	28	10,826	−44.7	----	28	10,371	−53.0	----	26	10,281	−50.1	----	29	10,432	−48.6	----
200	27	12,279	−55.9	----	20	11,765	−56.1	----	23	11,730	−53.0	----	27	11,873	−54.1	----
175	24	13,119	−61.5	----	15	12,613	−54.4	----	14	12,576	−53.2	----	20	12,720	−56.0	----
150	20	14,060	−66.9	----	11	13,583	−54.1	----	10	13,597	−57.3	----	13	13,682	−58.1	----
125	15	15,152	−69.6	----	----	----	----	----	7	14,777	−59.3	----	----	----	----	----
100	6	16,460	−72.6	----	----	----	----	----	----	----	----	----	----	----	----	----

[1] Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T., except at Ciudad Victoria, Mazatlan, and Merida, where they are taken near 0200, G. C. T.

"Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C.

All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 5 p. m., E. S. T. (2200 G. C. T.) during November 1947. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Velocities in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,630 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (512 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	25	213	1.5	30	285	1.9	21	301	2.6	29	251	2.4	29	309	4.3	29	322	2.8	28	72	1.9
500							21	295	3.6										28	75	2.1
1,000	25	221	2.8				21	301	3.9				29	321	5.4	29	320	3.1	25	132	1.1
1,500	23	240	4.7				20	296	5.9	29	273	4.8	19	314	6.9	29	309	4.4	25	271	1.3
2,000	23	248	6.6	30	275	3.3	20	298	8.7	26	291	7.3	14	318	8.5	26	306	4.9	21	277	4.2
2,500	22	263	7.7	30	271	4.3	19	286	13.0	24	299	8.7	12	297	10.2	21	311	6.9	21	263	6.2
3,000	21	273	10.1	30	269	6.8	19	282	15.6	18	302	8.6	10	300	13.8	19	312	6.3	21	260	7.8
4,000	21	275	14.3	24	269	9.7	14	274	19.6	14	289	9.8				12	315	4.9	18	260	10.0
5,000	19	279	18.3	20	278	12.9	11	267	24.5	13	294	9.8							16	262	11.6
6,000	18	270	20.4	19	266	20.1				11	292	10.8							16	263	14.6
8,000				13	278	23.3													10	254	18.2
10,000				11	287	31.5															

Altitude (meters) m. s. l.	Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (276 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,198 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	29	244	2.1	28	299	1.0	22	291	0.9	29	258	1.8	29	339	2.0	30	267	2.8
500	29	242	3.6	28	268	2.4	22	293	2.0	29	265	2.1						
1,000	25	245	4.4	27	263	4.0	22	287	3.7	24	243	2.9						
1,500	18	234	5.5	19	297	4.2	22	280	7.2	21	249	3.2				30	264	3.1
2,000	13	245	6.8	13	311	3.7	20	276	9.8	17	268	4.8	29	322	2.6	30	255	3.4
2,500	12	254	8.0	11	302	5.9	19	273	13.6	15	279	7.8	28	288	3.5	29	256	6.6
3,000	10	258	5.7				18	276	16.2	13	285	12.1	26	281	5.6	27	262	10.4
4,000							15	275	15.5	13	279	16.4	26	299	9.1	25	265	13.4
5,000							13	270	20.7	10	284	22.0	23	300	12.3	24	265	18.0
6,000							10	266	22.4				21	294	13.3	20	269	18.6
8,000													13	284	16.5	16	266	23.2
10,000																10	258	26.0

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (575 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	352	2.4	29	295	1.8	25	319	1.4	23	286	2.2	25	337	0.7	27	260	2.3	30	8	1.2
500							25	316	2.0				25	265	2.1	27	265	3.4			
1,000							23	290	3.8	23	278	4.0	24	259	4.3	22	247	4.3	30	22	1.9
1,500				29	295	1.9	22	289	6.9	23	296	5.6	23	272	6.7	18	248	4.5	30	345	2.1
2,000	30	353	2.4	29	292	1.7	22	293	10.3	21	304	7.8	20	277	9.9	14	280	4.9	30	326	3.0
2,500	30	332	2.5	29	245	2.1	19	293	14.2	18	306	9.2	19	275	11.1	12	299	6.4	30	324	3.8
3,000	28	321	2.9	28	251	3.2	18	290	17.3	16	303	10.5	18	275	12.4	11	297	11.2	29	329	4.3
4,000	24	311	6.4	22	280	5.3	17	278	19.0	11	281	9.1	16	272	15.6				26	313	8.4
5,000	19	310	7.9	19	302	8.2	13	276	28.1				15	269	20.5				25	305	11.1
6,000	16	319	8.8	15	292	11.2							13	264	22.6				21	303	15.2
8,000	11	311	14.2																13	288	19.0

Altitude (meters) m. s. l.	Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (12 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (194 m.)			New York, N. Y. (15 m)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	24	314	1.2	28	338	1.1	29	125	0.7	26	3	1.9	25	278	2.0	29	312	3.6
500	24	300	1.7	28	344	1.2	29	119	1.0	26	355	1.9	25	270	4.2	29	309	3.7
1,000	22	278	2.7	27	313	1.2	29	179	1.1	21	333	2.4	25	264	4.2	28	305	4.2
1,500	21	279	4.9	24	321	1.6	29	239	2.3	20	311	4.9	24	279	7.2	23	310	5.7
2,000	20	279	8.8	22	341	3.3	26	255	3.7	19	294	7.9	18	279	10.5	19	312	7.8
2,500	17	277	10.3	16	6	6.1	24	252	4.8	18	285	9.5	15	289	11.7	18	296	8.3
3,000	17	279	12.5	12	8	8.3	23	255	5.2	18	276	12.8	14	289	14.0	14	296	8.8
4,000	15	280	17.1	12	352	13.6	16	257	9.2	16	263	16.1	11	283	17.6			
5,000	11	283	22.4				16	253	10.4	14	263	18.2	11	278	22.6			
6,000							13	252	12.3									
8,000																		

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Louis, Mo. (181 m.)			St. Cloud, Minn. (318 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	30	298	2.4	28	205	1.0	28	276	1.5	30	257	0.7	26	328	4.6	28	287	1.4	23	265	2.0
500	30	344	3.6	28	211	1.3	28	273	2.4	30	259	.8				28	255	2.2	23	272	2.8
1,000	29	360	5.2	26	252	1.5	26	277	4.7	30	221	1.0	26	325	4.9	27	246	3.6	22	277	4.7
1,500	28	357	6.6	21	259	4.8	21	283	8.8	30	181	1.1	26	317	7.6	19	268	7.4	18	283	6.5
2,000	27	357	7.2	19	261	6.6	19	288	11.7	29	229	1.1	23	308	10.0	17	272	9.6	13	288	9.5
2,500	27	350	7.7	19	265	8.4	15	294	14.2	26	283	2.1	23	306	12.4	16	281	12.0	10	287	11.2
3,000	26	354	9.7	16	283	10.4	14	296	16.7	26	288	4.7	21	309	14.1	11	289	14.6			
4,000	24	348	14.5	14	283	14.9	12	282	19.8	25	287	8.1	15	306	13.8						
5,000	21	344	13.2	13	272	17.8	10	281	23.1	24	290	11.1	12	286	9.6						
6,000	21	336	14.2	12	278	21.6	10	280	24.1	19	295	13.7	12	284	10.2						
8,000	10	321	16.5							14	296	13.8									
10,000																					

Altitude (meters) m. s. l.	San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (225 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (603 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity	Observations	Direction	Velocity
Surface	27	358	1.0	30	282	3.2	20	235	1.5	23	172	0.5	24	247	0.6	25	312	2.2
500	27	3	.3	30	285	3.1	20	194	2.4	23	235	1.2				25	308	4.2
1,000	26	214	1.2	29	303	1.5	18	214	3.4	20	212	2.2	24	226	1.8	25	305	5.7
1,500	24	235	2.5	27	353	1.4	13	211	3.7	16	258	2.8	20	262	3.6	25	295	6.3
2,000	24	250	4.6	26	359	2.6				12	289	2.4	13	286	3.9	22	287	9.0
2,500	24	265	6.7	25	343	4.3							10	300	4.8	19	284	13.1
3,000	24	267	11.2	25	328	6.2										16	281	14.8
4,000	20	268	14.1	24	320	7.8										14	276	19.0
5,000	17	271	19.1	23	321	11.2										10	284	24.2
6,000	16	268	22.8	22	310	13.4												
8,000	13	264	26.8	19	301	15.0												
10,000				11	301	15.0												

TABLE 3.—*Maximum free-air wind velocities (m. p. s.) for different sections of the United States based on pilot balloon observations during November 1947*

Section	Surface to 2,500 meters (m. s. l.)					2,501 to 5,000 meters (m. s. l.)					Above 5,000 meters (m. s. l.)				
	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station	Maximum velocity	Direction	Altitude (m.) m. s. l.	Date	Station
Northeast [1]	41.8	ssw.	1,903	7	Akron, Ohio	51.0	wnw.	4,795	9	Pittsburgh, Pa.	82.5	wnw.	9,644	18	Albany, N. Y.
East-Central [2]	38.1	wnw.	2,500	9	Lynchburg, Va.	56.0	wnw.	4,063	8	Chattanooga, Tenn.	80.0	w.	10,024	12	Huntington, W. Va.
Southeast [3]	42.0	w.	2,500	25	Charleston, S. C.	47.1	wsw.	5,000	8	Atlanta, Ga.	79.0	w.	12,670	9	Charleston, S. C.
North-Central [4]	41.4	wsw.	1,273	30	Fargo, N. Dak.	50.0	wnw.	4,030	11	International Falls, Minn.	73.0	wsw.	9,273	23	Madison, Wis.
Central [5]	42.5	nnw.	2,500	24	Dodge City, Kans.	46.4	wsw.	4,998	23	Joliet, Ill.	90.0	wnw.	8,578	9	Joliet, Ill.
						46.4	nw.	4,963	26	Goodland, Kans.					
South-Central [6]	38.6	wsw.	2,096	6	Tulsa, Okla.	65.0	wnw.	4,920	14	San Antonio, Tex.	82.0	wsw.	9,938	7	Fort Worth, Tex.
Northwest [7]	33.4	nw.	2,000	24	Glasgow, Mont.	46.4	n.	5,000	23	Glasgow, Mont.	67.0	wnw.	18,765	29	Billings, Mont.
	33.4	nw.	2,500	11	Burns, Oreg.										
West-Central [8]	38.5	wnw.	2,489	15	Cheyenne, Wyo.	46.0	nnw.	3,587	26	Cheyenne, Wyo.	89.0	wsw.	20,509	25	Red Bluff, Calif.
Southwest [9]	35.8	wsw.	2,474	5	Winslow, Ariz.	47.3	w.	5,000	6	El Paso, Tex.	98.0	wsw.	11,618	21	El Paso, Tex.

[1] Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, and northern Ohio.
[2] Delaware, Maryland, Virginia, West Virginia, southern Ohio, Kentucky, eastern Tennessee, and North Carolina.
[3] South Carolina, Georgia, Florida, and Alabama.
[4] Michigan, Wisconsin, Minnesota, North Dakota, and South Dakota.
[5] Indiana, Illinois, Iowa, Nebraska, Kansas, and Missouri.
[6] Mississippi, Arkansas, Louisiana, Oklahoma, Texas (except El Paso), and western Tennessee.
[7] Montana, Idaho, Washington, and Oregon.
[8] Wyoming, Colorado, Utah, northern Nevada, and northern California.
[9] Southern California, southern Nevada, Arizona, New Mexico, and extreme west Texas.

RIVER STAGES AND FLOODS FOR NOVEMBER 1947

ELMER R. NELSON

Precipitation during November was above normal in the eastern two-thirds of the United States except in Maine, the upper Great Lakes region, and along a narrow belt extending southwestward from the lower Great Lakes region through the central portion of Texas. In the remaining one-third of the country it was below normal except in eastern Oregon, the northern portions of Nevada and Utah, western Idaho, the southeastern tip of Washington, and the southwestern corner of Montana. Rainfall was comparatively heavy in a broad area along the Atlantic from Pennsylvania through the Southern States. It was also heavy over Minnesota, South Dakota, and Wyoming. The precipitation in these areas ranged from 1½ to 3 times the normal seasonal amounts. Near-drought conditions were prevalent again over Maine except in the extreme southeastern portion.

Stream flow was excessive in the Southern States over a broad region extending from the Mississippi River to the Atlantic coast, but no damaging floods were reported. In southern Florida, run-off continued excessive as stages receded slowly following the October floods. Streams continued low over most of New England for the third consecutive month. Over the central and southern Great Plains stream flow continued subnormal for the second consecutive month, while in the West there was a general trend toward normal seasonal run-off.

Atlantic Slope drainage—The moderate to heavy precipitation that occurred on the first 4 days of the month in the Atlantic Coast States caused minor overflows in some of the river basins from Virginia southward to Georgia. The rainfall was especially heavy over New Jersey; the eastern portions of Pennsylvania, Maryland, and Virginia; and the northeastern tip of North Carolina. It was moderately heavy over most of South Carolina, the central portion of Georgia, and the sandhills of North Carolina. The first overflow since June 1946 occurred in the Washington River District on the Rapidan River at Rapidan, Va., on the 4th. Minor overflows occurred on the Roanoke and Cape Fear Rivers in North Carolina, the Pee Dee, Saluda, Broad, Catawba, and Wateree Rivers in South Carolina. The small disturbance that developed over Alabama on the 11th of the month was accompanied by generally heavy rains and caused additional minor overflows along some of the rivers in North Carolina, South Carolina, and Georgia. Monthly rainfall totals at many stations in Georgia were the greatest on record for any November. The rainfall in that area was frequent, with numerous heavy falls through the Apalachicola and Altamaha River systems. The principal losses in the Atlantic Slope drainage area during the month were to logging interests.

East Gulf of Mexico drainage.—The rainfall in November was frequent in occurrence, with numerous heavy falls in the Apalachicola River system which caused that river to be slightly over flood stage from the 15th through the 30th at Blountstown, Fla.

West Gulf of Mexico drainage.—The Sabine River at Mineola, Tex., went 2 feet above flood stage on the 28th. No damage was reported.

Pacific Slope drainage.—In the Pacific Northwest minor flooding occurred in the Columbia, Puyallup, and the Snohomish River basins. The only damage was that due to erosion.

FLOOD STAGE REPORT FOR NOVEMBER 1947

[All dates in November unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE	*Feet*			*Feet*	
Rapidan: Rapidan, Va	14	4	4	15.2	4
Roanoke:					
Randolph, Va	21	4	5	23.2	5
Weldon, N. C	31	6	6	31.6	6
		13	13	33.0	13
Williamston, N. C	10	8	[2]	11.3	20–21
Tar: Rock's Mount, N. C	8	14	15	8.2	14–15
Neuse:					
Neuse, N. C	14	13	17	16.7	14
		21	21	14.0	21
Smithfield, N. C	13	5	5	13.2	5
		12	23	17.0	17
Goldsboro, N. C	14	13	[2]	18.0	21
Kinston, N. C	14	15	[2]	16.7	27
Cape Fear: Lock No. 2, Elizabethtown, N. C.	20	12	20	25.8	13–14
				25.0	17
		20	22	20.8	21
Pee Dee: Pee Dee, S. C	19	6	27	20.0	9
				21.7	20
Saluda:					
Pelzer, S. C	6	2	4	6.4	3
		16	16	6.0	16
Chappells, S. C	13	11	11	13.2	11
Broad: Blairs, S. C	14	3	4	18.1	4
		12	13	15.5	12
		16	16	14.0	16
Catawba:					
Catawba, N. C	8	3	4	11.9	3
Catawba, S. C	11	3	4	14.6	4
Wateree: Camden, S. C	23	4	5	24.9	4
Edisto:					
Orangeburg, S. C	8	13	15	8.1	13
		17	20	8.1	18
Givhans Ferry, S. C	10	13	[2]	11.7	25
Ogeechee: Dover, Ga	7	13	[2]	8.0	24
Ocmulgee: Abbeville, Ga	11	19	29	11.9	21
Oconee: Milledgeville, Ga	20	12	12	21.6	12
Altamaha:					
Charlotte, Ga	12	14	[2]	17.2	27
Piney Bluff, Ga	17	23	[2]	19.0	26
EAST GULF OF MEXICO DRAINAGE					
Apalachicola: Blountstown, Fla	15	15	[2]	17.2	23
WEST GULF OF MEXICO DRAINAGE					
Sabine: Mineola, Tex	14	25	29	16.0	28
PACIFIC SLOPE DRAINAGE					
Columbia Basin					
Santiam: Jefferson, Oreg	13	8	9	13.7	8
		16	16	13.8	16
Willamette: Harrisburg, Oreg	12	15	16	12.2	15
Puyallup Basin					
Puyallup: Electron Headworks, Wash	7.9	7	8	8.2	7
Snohomish Basin					
Snoqualmie: Tolt, Wash	51.8	7	9	54.0	8
		11	11	52.0	11
Snohomish: Snohomish, Wash	20	7	11	25.4	8

[1] Provisional.
[2] Continued at end of month.

CLIMATOLOGICAL DATA FOR NOVEMBER 1947

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1943, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	° F.	° F.		° F.			° F.		In.	In.		In.		In.
Alabama	53.2	−1.2	Dothan	81	5	3-stations	22	29	8.09	+4.88	Tibbie	13.52	Guntersville	3.92
Arizona	46.3	−4.3	Ehrenberg	97	2	Alpine	−10	24	.89	−.07	2-stations	4.01	3-stations	.00
Arkansas	47.7	−3.6	2-stations	82	1	Harrison	17	30	5.06	+1.21	Fordyce	9.18	Fort Smith Airport	2.28
California	48.2	−3.8	do	92	1	Tamarack	−4	21	.88	−1.55	Crescent City	3.67	9-stations	.00
Colorado	30.5	−4.7	Arriba	76	1	Sugar Loaf	−21	22	.72	−.06	Wolf Creek Pass	5.68	2-stations	.00
Florida	67.0	+1.9	Homestead	91	19	2-stations	32	30	5.84	+3.63	Marianna	15.28	Merritt Island	1.32
Georgia	52.3	−2.3	2-stations	82	5	Blairsville	17	29	7.92	+5.25	Hoggards Mill	12.61	Brunswick	3.76
Idaho	32.3	−3.0	do	78	1	2-stations	−15	22	2.21	+.10	Roland	10.11	Howe	.08
Illinois	37.6	−4.5	Harrisburg	69	6	Rockford Airport	−20	30	2.40	−.24	Du Quoin	6.78	Springfield	.98
Indiana	38.6	−3.8	Tell City	72	6	2-stations	−2	30	1.98	−1.06	La Porte	3.90	Noblesville	.78
Iowa	32.7	−4.9	Clarence	65	3	Decorah	−22	30	1.84	+.11	Storm Lake	3.18	2-stations	.83
Kansas	39.5	−3.7	Columbus	72	6	Bison	−8	22	1.17	−.10	Hill City	2.75	Richfield	.22
Kentucky	44.2	−2.3	Middlesboro	70	5	2-stations	11	30	2.82	−.57	Paducah	4.82	Grant	1.76
Louisiana	57.2	−1.7	Winnfield	88	1	Robeline	25	29	9.58	+5.55	Belle Chasse	15.36	Plain Dealing	4.40
Maryland-Delaware	43.4	−1.9	Lewes, Del	70	4	Oakland, Md	5	30	5.35	+2.72	Wilmington, Del	8.11	Hancock, Md	3.20
Michigan	33.6	−2.7	2-stations	68	1	Kenton	−11	30	2.41	−.12	Painesdale	4.61	2-stations	1.21
Minnesota	24.3	−5.2	Albert Lea	63	3	Angus	−29	29	2.33	+1.15	Pigeon River Bridge	4.98	Big Falls	.50
Mississippi	53.1	−2.0	6-stations	80	[1] 1	Moorhead	20	30	7.72	+3.98	Biloxi	14.29	Hernando	4.38
Missouri	41.0	−3.4	3-stations	73	[1] 4	4-stations	9	[1] 24	2.65	−.06	Caruthersville	5.92	Waynesville	1.26
Montana	28.3	−3.6	Harlem	82	1	Butte Airport	−23	22	1.26	+.22	Hebgen Dam	4.80	2-stations	.04
Nebraska	32.9	−4.3	Curtis	69	1	Nenzel (near)	−15	22	1.51	+.74	Madison	2.73	Benkelman	.40
Nevada	35.8	−4.0	Overton	84	1	Winnemucca	−8	22	.70	−.01	Jarbidge	3.37	2 stations	.00
New England	36.0	−2.1	2 stations	68	3	Greenville, Maine	−6	30	5.10	+1.54	Washington, Conn	8.78	Bethlehem, N. H	2.19
New Jersey	42.0	−1.9	Clayton	67	2	Layton	10	30	6.49	+3.23	2 stations	11.24	Atlantic City	3.14
New Mexico	38.1	−4.3	Rodeo	83	2	Selson Ranch	−18	24	.67	+.03	Batemano Ranch	1.92	Abar	.00
New York	35.9	−2.3	6 stations	67	[1] 1	Stillwater Reservoir	−2	27	4.28	+1.22	Yorktown Heights	8.90	Wilson	1.32
North Carolina	47.8	−2.2	3 stations	80	[1] 1	Mount Mitchell	11	25	6.17	+3.47	Edenton	11.39	Enfield	2.24
North Dakota	22.5	−4.1	4 stations	63	[1] 1	3 stations	−19	29	1.05	+.44	Oakes	2.74	Dickinson Airport	.3
Ohio	39.2	−2.3	Jackson	69	10	2 stations	2	30	2.27	−.42	Summerfield	5.16	New Lexington	1.16
Oklahoma	46.0	−3.8	3 stations	78	[1] 1	Kenton	−5	22	2.12	+.07	Bear Mountain Tower	6.67	Kenton	.23
Oregon	39.1	−1.2	Lake Creek	80	1	Austin	−5	22	3.11	−.62	Headworks	13.55	Fremont	.15
Pennsylvania	38.3	−3.0	Marcus Hook	71	5	Philipsburg	0	30	4.22	+1.32	West Chester	9.02	Covington	1.90
South Carolina	51.1	−2.7	Ridgeland	81	6	Walhalla	20	27	7.37	+4.98	Hartsville	11.46	Summerville	3.14
South Dakota	27.3	−5.8	Deadwood	73	2	Castlewood	−19	29	1.74	+1.16	Forestburg	4.45	Ludlow	.26
Tennessee	46.9	−1.7	3 stations	71	[1] 5	Union City	12	30	4.38	+.79	Bolivar	7.45	Nashville (C. O.)	2.74
Texas	54.1	−3.0	Rio Grande	99	[1] 1	Muleshoe	10	11	2.68	+.56	Bon Wier	9.28	Valentine	.20
Utah	31.9	−5.3	Zion National Park	83	1	Woodruff	−18	22	1.61	+.60	Alta	8.57	Mexican Hat	.12
Virginia	45.4	−1.3	Clarksville	75	[1] 1	Big Meadows	11	27	4.60	+2.14	Randolph	10.05	Davenport	1.48
Washington	39.3	−.1	Richland	71	10	Stockdill Ranch	4	21	3.61	−.71	Paradise R. S.	20.48	Grand Coulee Dam	.13
West Virginia	42.0	−1.3	2 stations	74	[1] 6	Bayard	6	30	3.03	+.27	Stony River Dam	6.41	Vandalia	1.10
Wisconsin	29.0	−4.4	Darlington	63	2	Lone Rock	−22	30	2.21	+.30	Spooner	3.63	Blair	1.13
Wyoming	25.7	−5.8	Basin	85	1	Dillinger	−26	22	1.36	+.62	Snake River	5.07	Buffalo Bill Dam	.26
Alaska (Oct.)	30.6	+.1	Ketchikan	62	7	Wiseman	−10	30	3.23	−.44	Baranof	39.92	Savoonga	T
Hawaii	72.3	+.7	Waianae	92	1	Haleakla R. S.	39	6	7.17	−.49	Waiawa	29.88	2 stations	.00
Puerto Rico	76.7	+.2	Dos Bocas	96	3	Guineo Reservoir	55	26	3.27	−3.68	Adjuntas	7.74	Mona Island	.92

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR NOVEMBER 1947

District and station	Elevation of instruments: Barometer above sea level[1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air: Mean	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Total degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Wind: Average hourly velocity	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
NEW ENGLAND	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F.	°F.	°F		°F	°F		°F	°F		°F	%	In.	In.	In.		Mi.								0-10	In.	In.	
							38.8	-0.1										77	5.04	+1.8											6.3			
Eastport	75	67	82	1,011.9	1,014.9	-1.7	38.4	+1.7	58	2	44	24	27	33	25	797	31	76	4.68	+1.4	1.98	12	12.7	nw.	42	e.	9	4	6	20	7.5	4.0	0.0	0
Greenville, Maine	1,069	4	41	976.0	1,016.6	-1.0	28.9	-1.7	60	3	38	-6	30	20	42	1,081	24	88	5.54	+2.5	2.07	12	5.7	n.	20	------	10	4	6	20	----	24.7	16.0	0
Portland, Maine[2]	103	6	43	1,012.2	1,015.9	-2.1	39.4	+1.4	61	2	47	22	30	32	28	771	28	78	4.87	+1.4	2.67	7	9.1	n.	44	se.	8	14	6	10	5.0	T	.0	0
Concord[2]	289	5	45	1,005.8	1,016.6	-1.7	34.6	-.8	65	3	44	10	30	25	44	916	26	78	6.68	+3.6	2.89	5	7.3	nw.	36	e.	8	9	5	16	6.0	2.9	.0	0
Burlington[2]	403	6	51	1,001.4	1,016.6	-1.0	34.2	-2.1	62	3	42	13	30	26	37	925	28	83	3.20	+.5	1.41	8	8.3	nw.	31	s.	22	4	6	20	7.3	5.9	1.2	0
Boston[2]	124	33	62	1,011.8	1,016.5	-1.5	41.2	-.8	59	3	48	25	30	35	21	715	30	69	5.13	+1.8	3.32	7	12.7	nw.	42	se.	8	9	6	15	5.9	1.1	.0	0
Nantucket[2]	12	4	34	1,015.2	1,015.9	-1.7	42.6	-1.8	58	3	49	21	27	36	25	677	34	76	3.28	+.1	1.29	12	15.0	nw.	58	nw.	12	6	6	18	6.9	T	.0	0
Block Island	26	11	46	1,014.6	1,015.6	-2.4	44.2	-.4	62	8	50	28	30	39	20	620	38	80	3.67	.0	1.23	10	20.0	nw.	67	nw.	12	9	5	16	6.3	.0	.0	0
Providence[3]	159	65	60	1,010.5	1,016.6	-1.7	41.6	+1.2	63	3	49	23	30	35	28	703	30	76	5.42	+2.4	3.61	7	9.1	n.	42	nw.	12	10	5	15	5.9	.2	.0	0
Hartford[2]	159	5	44	1,010.8	1,016.9	-1.7	39.8	+.3	62	5	48	15	30	31	30	758	30	76	5.23	+1.7	2.46	9	8.2	n.	40	se.	8	8	6	16	6.4	.4	T	0
New Haven[2]	107	5	39	1,012.9	1,016.9	-2.1	41.6	+1.7	62	5	49	21	30	34	26	701	30	68	7.77	+4.7	3.69	10	8.6	n.	40	se.	8	10	7	13	5.8	T	.0	1
MIDDLE ATLANTIC																																		
							44.1	-.6										75	5.08	+2.6											6.4			
Albany[2]	97	6	40	1,013.5	1,017.3	-1.3	35.6	-.7	61	2	44	14	30	27	37	881	28	80	3.94	+1.5	1.57	10	8.3	w.	33	w.	12	6	5	19	6.9	3.3	.2	0
Binghamton[4]	871	57	79	985.1	1,017.6	-1.0	37.0	-1.7	64	3	45	15	30	29	35	845	29	82	3.30	+.9	1.74	14	6.4	w.	24	w.	25	4	6	20	7.7	4.1	.1	0
New York[4]	314	415	454	1,006.1	1,017.6	-1.4	44.0	-.2	60	5	50	26	30	38	20	631	33	66	6.50	+3.5	2.13	10	15.6	nw.	57	nw.	12	9	10	11	5.9	T	.0	0
Harrisburg[2]	374	30	49	1,005.8	1,019.0	-1.0	41.5	-1.3	60	7	48	23	30	35	24	703	31	68	5.59	+3.3	1.98	9	8.3	nw.	30	nw.	12	5	12	13	6.5	2.9	.0	2
Philadelphia[4]	114	174	150	1,013.5	1,017.6	-2.4	45.0	-.7	63	4	51	27	30	39	21	598	34	74	6.57	+3.9	2.21	10	8.4	n.	26	ne.	3	7	11	12	6.0	T	.0	1
Reading	323	47	306	1,006.1	1,018.3	-1.7	42.8	-1.1	62	6	50	24	30	36	24	664	----	---	6.34	+3.6	1.80	10	11.5	nw.	35	nw.	12	9	7	14	6.1	T	.0	1
Scranton	805	72	104	987.5	1,017.3	-2.0	38.9	-1.6	61	3	45	20	30	32	28	784	----	---	3.60	+.8	1.39	13	6.9	sw.	27	se.	8	4	11	15	7.0	1.3	T	0
Atlantic City	52	37	172	1,015.6	1,017.6	-2.0	45.9	+.3	64	3	52	27	27	39	21	573	38	76	3.14	+.3	1.13	9	16.5	w.	50	se.	8	7	10	13	6.5	.0	.0	2
Trenton	190	89	107	1,010.5	1,018.0	-1.3	43.4	-1.0	62	8	50	26	30	37	22	654	----	---	4.84	+2.1	1.31	10	9.4	n.	34	ne.	4	8	10	12	6.1	.0	.0	1
Baltimore[4]	123	100	215	1,013.5	1,018.0	-2.0	46.4	+.1	63	6	52	28	30	40	22	561	34	67	6.92	+4.4	2.79	8	10.4	nw.	38	w.	24	5	13	12	6.3	T	.0	2
Washington[4]	112	56	100	1,014.6	1,018.6	-1.7	46.4	+1.2	66	5	54	26	30	39	28	558	38	75	5.09	+2.7	1.57	8	7.7	nw.	31	n.	8	5	15	10	4.8	.0	.0	2
Cape Henry	18	8	54	1,016.3	1,016.9	-3.1	52.2	+.1	70	5	57	32	29	47	26	387	44	76	4.82	+2.5	1.46	10	15.1	n.	43	nw.	12	5	11	14	6.4	T	.0	1
Lynchburg[2]	686	5	58	992.9	1,018.3	-2.7	44.2	-1.0	71	5	52	25	27	36	31	628	34	76	4.13	+1.8	1.09	12	8.3	n.	29	n.	3	8	7	15	6.2	.7	.0	1
Norfolk[4]	91	80	125	1,014.2	1,017.6	-3.1	51.4	.0	70	5	58	31	30	45	26	407	42	76	6.25	+4.1	2.64	12	10.4	n.	39	se.	3	5	8	17	6.9	T	T	1
Richmond[4]	144	11	52	1,011.9	1,017.3	-3.4	47.0	-1.3	70	5	55	26	30	39	31	544	38	82	5.17	+3.0	1.62	9	7.3	ne.	30	e.	3	4	8	18	7.0	.6	.0	1
SOUTH ATLANTIC																																		
							52.5	-.9										82	6.22	+3.8											6.6			
Asheville	2,253	77	92	937.4	1,018.3	-3.7	45.1	0	70	5	53	25	29	37	31	602	36	78	3.17	+.9	1.21	12	8.8	nw.	40	w.	24	11	5	14	5.8	.0	.0	0
Charlotte[4]	779	63	86	989.2	1,017.6	-3.4	48.4	-2.2	70	5	56	31	30	41	27	496	38	78	7.94	+5.4	2.54	14	6.8	ne.	27	ne.	2	9	4	17	6.4	.0	.0	2
Greensboro[2]	886	6	56	986.1	1,018.6	-2.7	45.4	-1.3	70	5	54	24	27	36	34	588	37	83	5.14	+2.7	1.19	14	8.3	ne.	33	ne.	2	6	9	15	6.5	T	.0	1
Hatteras	11	5	47	1,016.3	1,016.6	-3.4	56.8	+.5	73	3	62	39	30	52	18	251	48	78	6.09	+2.6	4.26	11	14.2	ne.	34	se.	11	8	9	13	6.5	.0	.0	0
Raleigh[4]	376	5	71	1,003.7	1,017.6	-3.4	48.4	-2.6	72	3	57	28	30	40	30	496	40	86	5.46	+3.2	1.65	13	6.9	n.	22	sw.	24	2	7	21	7.6	T	.0	1
Wilmington	72	73	107	1,014.6	1,017.3	-3.7	54.4	-1.6	75	3	62	32	30	46	28	324	48	85	7.15	+5.2	2.83	11	8.9	ne.	27	e.	2	9	6	15	6.1	.0	.0	2
Charleston[4]	48	11	92	1,014.9	1,016.6	-4.1	57.0	-1.1	76	5	63	41	27	51	24	244	48	88	6.28	+4.1	2.09	11	11.0	n.	39	e.	2	7	6	17	6.8	.0	.0	1
Columbia, S. C.[4]	347	70	91	1,004.4	1,017.3	-4.0	52.0	-2.1	73	6	60	32	27	44	28	389	43	83	6.33	+4.4	2.16	14	7.9	ne.	33	ne.	2	8	6	16	6.5	.0	.0	1
Greenville, S. C.[2]	1,040	18	36	979.7	1,017.3	-3.4	48.5	-1.1	71	5	56	26	29	41	35	491	39	79	6.66	+3.5	1.75	12	9.7	ne.	35	ne.	2	10	3	17	6.5	.0	.0	0
Augusta[4]	182	62	77	1,010.5	1,017.3	-3.4	52.8	-1.7	73	24	61	32	27	45	31	364	42	78	7.77	+5.4	2.92	14	5.8	nw.	22	ne.	2	8	4	18	6.6	.0	.0	4
Savannah[2]	65	19	51	1,014.6	1,016.9	-3.8	57.4	+.6	78	5	66	35	27	49	31	231	50	84	5.51	+3.4	1.87	13	9.4	ne.	32	nw.	8	6	7	17	6.8	.0	.0	2
Jacksonville[4]	43	86	110	1,014.9	1,016.6	-3.7	63.5	+1.3	83	23	71	41	27	56	25	118	54	84	7.12	+5.1	2.79	8	8.5	ne.	25	sw.	15	7	6	17	6.8	.0	.0	4
FLORIDA PENINSULA																																		
							74.5	+3.3										83	2.65	+.3											5.5			
Key West[4]	21	10	64	1,013.5	1,014.2	-3.1	78.5	+4.2	87	17	84	67	29	73	16	0	70	80	2.91	+.7	2.13	6	8.4	e.	54	nw.	28	10	11	9	5.1	.0	.0	3
Miami[4]	25	242	249	1,013.9	1,014.9	-3.1	76.1	+3.6	85	12	81	61	9	72	16	0	68	86	2.56	-.7	1.30	9	11.5	s.	38	ne.	28	9	14	7	5.3	.0	.0	0
Tampa[2]	35	5	36	1,014.2	1,015.6	-3.7	68.9	+2.0	85	22	77	44	9	61	27	48	61	84	2.49	+.8	1.02	10	7.9	ne.	27	s.	11	9	8	13	6.2	.0	.0	5
EAST GULF																																		
							55.1	-1.2										82	9.14	+5.4											6.6			
Atlanta[2]	1,173	33	72	974.9	1,017.3	-4.0	48.8	-2.7	72	5	56	31	27	41	29	486	40	79	9.05	+5.9	3.02	15	11.3	e.	45	ne.	1	9	5	16	6.3	.0	.0	1
Macon[4]	370	79	87	1,003.7	1,016.9	-4.1	51.9	-2.3	74	5	60	30	29	44	32	390	42	77	8.72	+6.2	2.15	15	6.3	n.	26	ne.	1	9	1	20	7.0	.0	.0	2
Thomasville	273	48	58	1,006.1	1,016.3	-3.7	58.8	+.3	78	5	67	36	27	50	28	210	----	---	9.34	+6.7	3.11	11	----	----	--	------	--	9	3	18	----	.0	.0	5
Apalachicola	35	11	51	1,014.9	1,015.9	-4.4	62.2	+.9	81	5	69	42	27	56	22	132	55	84	9.00	+5.9	3.99	15	9.2	n.	27	se.	1	6	8	16	6.8	.0	.0	6
Pensacola[4]	56	54	79	1,014.2	1,016.6	-4.1	59.6	-.6	79	5	67	39	29	52	24	180	52	82	14.50	+10.8	5.40	12	8.1	ne.	32	sw.	11	6	5	19	7.1	.0	.0	5
Anniston	618	6	32	998.3	1,018.3	-1.7	49.2	-3.0	74	5	60	23	29	39	40	476	42	85	6.50	-3.3	2.59	11	----	ne.	--	------	--	8	8	14	6.5	.0	.0	1
Birmingham[2]	700	5	63	991.9	1,017.6	-4.1	50.2	-1.2	72	4	60	24	29	40	38	443	42	81	5.83	+2.5	1.55	11	8.6	e.	31	e.	1	6	9	15	6.4	.0	.0	0
Mobile[4]	57	86	161	1,014.6	1,016.9	-3.4	58.2	-.4	77	5	66	37	29	50	26	208	50	84	10.70	+7.1	2.30	12	8.2	n.	25	nw.	11	6	6	18	6.8	.0	.0	5
Montgomery[4]	218	92	105	1,009.8	1,017.3	-4.0	54.3	-1.5	74	5	62	35	27	46	27	322	45	77	7.08	+3.8	2.25	13	7.1	e.	22	se.	1	8	6	16	6.6	.0	.0	3
Meridian[4]	375	67	92	1,003.4	1,016.9	-4.4	53.2	-1.0	76	4	63	30	29	44	35	353	46	85	7.92	+4.6	3.04	14	5.7	ne.	22	e.	7	6	12	12	6.4	.0	.0	4
Vicksburg[4]	247	82	102	1,007.8	1,016.6	-4.7	54.0	-2.6	74	4	62	35	12	46	27	326	44	88	6.61	+2.9	2.01	14	8.2	n.	27	sw.	14	9	5	16	6.3	.0	.0	5
New Orleans[4]	53	76	84	1,014.2	1,015.9	-4.8	61.2	-.4	80	4	68	44	12	55	22	140	54	84	14.41	+11.3	3.72	17	7.1	ne.	20	ne.	18	5	9	16	6.9	.0	.0	6
WEST GULF																																		
							56.6	-1.9										76	3.73	+.3											5.9			
Shreveport[2]	249	5	64	1,007.8	1,017.3	-3.7	53.0	-2.0	80	4	63	33	29	43	34	363	44	80	4.93	+1.3	1.42	13	8.5	nw.	30	se.	6	12	4	14	5.6	.0	.0	2
Fort Smith[2]	463	6	30	1,000.2	1,016.6	-3.7	47.6	-3.4	72	4	57	28	25	38	36	519	38	78	2.28	-.6	.91	10	7.8	e.	25	w.	7	10	4	16	5.9	.0	.0	2
Little Rock[2]	357	26	58	1,004.4	1,017.6	-3.1	48.2	-3.9	68	5	56	30	12	40	35	506	40	80	6.27	+2.1	1.91	14	7.6	ne.	29	se.	21	10	4	16	6.0	.0	.0	3
Austin[2]	605	10	41	994.9	1,016.6	-3.4	56.4	-2.1	91	10	68	35	12	45	38	283	43	70	2.07	-.2	.74	11	9.0	n.	29	n.	1	11	9	10	5.3	.0	.0	2
Brownsville[2]	57	5	54	1,011.5	1,013.5	-4.8	69.0	+1.8	94	4	79	48	8	59	30	40	60	82	1.76	-.5	.60	13	10.4	n.	34	w.	26	5	6	19	6.9	.0	.0	5
Corpus Christi[2]	20	6	33	1,014.6	1,015.2	-4.1	64.2	+1.4	93	10	74	39	8	54	35	99	55	79	8.53		3.44	12	11.4	ne.	41	ne.	11	8	5	17	6.2	.0	.0	6
Dallas[2]	512	3	45	998.3	1,016.9	-3.4	51.3	-5.1	78	6	61	30	28	41	40	412	42	76	2.81	+.3	1.65	9	8.8	n.	34	nw.	6	14	3	13	5.2	.0	.0	3
Fort Worth[2]	679	40	50	992.6	1,017.3	-2.7	51.6	-2.9	78	6	60	35	11	43	32	400	42	70	2.23	-.4	1.53	8	10.5	n.	38	nw.	6	13	5	12	5.3	.0	.0	2
Galveston[4]	54	122	129	1,014.2	1,016.3	-4.0	62.6	-.7	81	6	68	49	25	57	26	121	54	82	3.66	+.3	1.86	11	12.8	n.	42	n.	7	7	5	18	6.7	.0	.0	4
Houston[4]	138	157	190	1,010.8	1,016.3	-4.0	60.2	-.8	85	10	68	44	12	52	25	182	50	78	5.47	+1.6	1.57	14	10.0	nw.	34	nw.	7	9	7	14	6.3	.0	.0	6
Palestine	510	64	72	999.0	1,017.3	-3.4	54.3	-2.9	82	4	63	35	12	45	34	333	42	68	3.19	-.2	1.15	11	7.1	n.	26	nw.	6	9	9	12	5.5	.0	.0	1
Port Arthur[4]	34	59	134	1,014.9	1,016.3	-3.7	59.8	-1.3	82	4	68	42	29	52	29	185	50	82	4.34	+1.7	1.57	13	13.0	n.	42	n.	7	8	6	16	6.4	.0	.0	4
San Antonio[2]	693	8	51	991.2	1,015.9	-3.7	57.4	-2.9	89	10	70	30	8	41	43	253	44	67	1.01	-.9	.31	10	9.3	ne.	31	w.	14	10	8	12	5.7	.0	.0	3

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR NOVEMBER 1947—Continued

District and station	Elevation of instruments: Barometer above sea level[1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air: Mean	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Total degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Wind: Average hourly velocity	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
OHIO VALLEY AND TENNESSEE	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F	°F	°F		°F	°F		°F	°F		°F	%	In.	In.	In.		Mi.								0-10	In.	In.	
							42.5	−1.4										78	2.88	−0.2											7.0			
Chattanooga[2]	762	6	66	989.8	1,017.6	−4.1	48.6	+.7	70	4	57	24	29	40	37	495	40	80	5.94	+2.6	2.44	13	7.1	s.	40	w.	24	9	6	15	6.2	.0	.0	1
Knoxville[5]	995	27	71	981.4	1,018.0	−3.3	47.8	+1.3	68	5	56	27	30	40	26	513	38	76	3.33	+.3	1.26	15	8.0	sw.	40	w.	24	8	6	16	6.6	.0	.0	0
Memphis[2]	399	5	49	1,002.7	1,016.9	−4.1	48.6	−1.5	70	6	58	25	30	39	32	493	40	79	5.07	+.8	2.00	12	7.6	n.	24	nw.	11	9	7	14	6.0	.0	.0	3
Nashville[2]	546	5	72	997.6	1,017.6	−4.1	47.4	−1.6	67	4	56	23	30	39	29	530	38	77	3.21	−.3	1.09	9	8.7	sw.	43	se.	7	6	12	12	6.3	.0	.0	0
Lexington[2]	989	4	58	981.0	1,018.3	−1.7	41.8	−3.0	65	10	50	15	30	34	28	696	34	80	3.32	.0	1.26	12	----	sw.	--	------	--	6	6	18	6.7	T	.0	0
Louisville[2]	525	5	54	998.3	1,017.6	−3.1	42.7	−2.3	65	10	51	16	30	35	28	671	34	75	2.30	−1.3	.79	11	8.1	sw.	33	se.	7	7	5	18	7.1	T	.0	1
Evansville[2]	431	6	40	1,001.7	1,018.0	−3.0	41.8	−2.6	63	6	50	15	30	33	31	694	36	84	2.18	−1.6	.62	14	8.4	w.	34	w.	24	5	5	20	7.3	T	.0	0
Indianapolis[2]	823	5	54	986.1	1,016.9	−3.1	37.8	−2.9	60	1	46	8	30	30	27	816	30	78	1.44	------	.32	12	11.1	w.	34	w.	8	7	3	20	7.2	.2	.0	0
Terre Haute[4]	575	4	36	996.6	1,018.0	−2.0	38.2	−4.2	62	1	46	8	30	30	28	802	32	79	1.15	−2.2	.28	10	9.8	w.	27	s.	10	4	7	19	7.6	.2	.0	0
Cincinnati[4]	627	135	148	994.6	1,018.0	−2.7	43.2	+.7	66	10	50	16	30	36	23	653	32	78	2.32	−.5	.83	12	5.1	w.	15	se.	7	8	3	19	7.0	T	.0	0
Columbus[4]	822	90	110	987.5	1,017.3	−3.0	40.5	−1.4	63	7	46	14	30	34	26	733	32	77	1.76	−1.0	.46	11	10.3	sw.	38	sw.	24	6	5	19	7.2	.4	.0	0
Dayton[2]	1,003	6	55	980.7	1,018.0	−2.0	38.2	−2.2	61	7	45	12	30	31	27	807	31	80	1.54	−1.3	.35	10	12.3	w.	45	se.	7	6	4	20	7.1	.2	.0	0
Elkins[2]	1,947	5	45	947.5	1,018.0	−3.7	39.4	+.1	61	5	48	10	30	31	35	768	32	78	3.00	+.2	.98	13	8.5	w.	39	w.	24	3	3	24	7.8	T	.0	1
Parkersburg	637	77	84	994.2	1,017.6	−3.4	43.0	−.8	65	10	50	18	30	36	32	661	33	72	3.54	+1.0	1.24	12	6.7	nw.	24	w.	24	5	5	20	7.2	.4	.0	0
Pittsburgh[2]	842	39	54	986.5	1,017.6	−2.4	39.2	−2.0	61	10	46	16	30	33	33	773	30	72	3.09	+.8	.81	11	10.9	sw.	41	w.	24	4	9	17	7.4	.6	.2	0
LOWER LAKES																																		
							37.4	−1.3										80	2.92	+.1											7.4			
Buffalo[2]	768	34	96	988.2	1,016.6	−1.4	38.0	−.5	65	3	44	17	30	32	29	810	30	77	4.01	+1.0	2.08	12	12.5	w.	36	sw.	24	3	9	18	7.2	9.9	.6	0
Canton	448	10	61	1,000.0	1,016.6	−.7	33.6	−1.4	63	3	42	7	27	26	36	944	28	84	3.20	.0	1.61	14	6.9	w.	25	w.	28	8	5	17	6.7	13.7	4.0	0
Oswego	335	71	85	1,004.4	1,016.9	−1.1	38.4	−1.0	64	3	44	20	30	33	25	797	30	72	3.75	+.4	1.37	18	10.0	se.	29	se.	7	2	8	20	7.8	17.7	6.3	2
Rochester[2]	523	4	69	997.6	1,017.6	−.7	37.4	+.7	62	7	45	15	30	30	34	829	30	83	2.59	.0	1.05	10	10.2	sw.	31	w.	24	3	11	16	7.4	2.0	1.0	0
Syracuse[2]	596	5	57	994.9	1,017.3	−1.3	37.2	.0	63	7	45	19	29	29	35	835	30	78	3.15	+.1	1.41	11	9.4	sw.	20	nw.	12	2	10	18	7.5	6.6	T	0
Erie[4]	714	57	81	990.2	1,016.9	−1.4	40.0	−1.4	60	2	46	21	30	34	22	748	31	80	6.22	+2.9	1.27	16	9.9	sw.	26	se.	7	4	5	21	7.7	35.1	11.8	1
Cleveland[2]	762	27	54	988.8	1,017.3	−1.7	38.2	−.8	61	7	45	12	30	32	30	806	31	80	2.01	−.6	.59	13	12.2	w.	37	w.	24	2	9	19	7.7	4.2	T	0
Sandusky	629	5	67	993.6	1,017.3	−1.3	38.5	−2.6	63	7	44	8	30	32	27	796	----	----	1.82	−.6	.47	13	10.2	sw.	26	sw.	24	4	11	15	7.1	3.5	.8	0
Toledo[2]	628	5	47	993.2	1,016.9	−2.4	36.8	−1.9	60	7	43	2	30	30	28	850	30	80	1.63	−.8	.43	12	11.2	sw.	34	sw.	7	1	10	19	7.9	4.5	.9	0
Fort Wayne[2]	857	5	34	985.1	1,016.9	−2.4	35.8	−3.0	58	1	42	10	30	29	24	874	30	84	1.91	−1.0	.55	11	9.0	w.	34	s.	7	6	2	22	7.5	1.0	T	0
Detroit[2]	730	5	77	989.8	1,016.9	−1.7	37.2	−2.0	58	3	43	13	30	31	20	835	30	78	1.80	−.6	.61	14	10.4	sw.	28	w.	22	3	6	21	7.5	3.1	1.7	0
UPPER LAKES																																		
							32.1	−2.4										82	2.39	.0											7.6			
Alpena	609	5	89	992.9	1,015.9	−1.0	34.4	.0	57	2	40	11	30	28	25	922	30	84	2.35	−.2	.77	14	10.6	sw.	45	se.	7	2	7	21	7.9	8.9	2.2	0
Escanaba	612	51	72	992.2	1,015.2	−1.7	31.8	−1.3	58	3	38	4	30	26	21	997	26	80	1.55	−.6	.91	11	10.6	w.	38	s.	7	6	9	15	6.7	6.9	1.0	0
Grand Rapids[4]	707	70	244	989.5	1,015.9	−2.1	36.8	−1.6	60	2	41	18	29	32	21	846	29	80	3.17	+.4	.83	14	11.2	sw.	39	sw.	7	1	7	22	8.5	17.2	3.1	0
Lansing[4]	878	5	90	983.7	1,016.6	−1.4	34.6	−2.9	58	2	41	11	30	28	23	910	28	80	1.99	−.5	.70	14	8.1	w.	24	sw.	7	3	8	19	7.9	10.0	3.4	0
Marquette	734	44	73	986.8	1,014.2	−2.4	30.5	−2.8	54	2	36	7	30	25	22	1,041	25	81	1.90	−1.0	.86	13	8.2	w.	29	s.	7	4	6	20	7.6	7.7	1.0	0
Sault Sainte Marie[2]	614	10	52	991.9	1,015.2	−1.4	30.6	+.2	60	3	37	2	30	24	24	1,034	26	88	2.74	−.3	.66	21	10.8	e.	39	se.	7	2	4	24	8.6	20.8	6.0	0
Chicago[2]	673	5	38	991.5	1,016.6	−2.0	34.6	−3.1	58	2	41	−1	30	28	24	914	28	78	2.63	+.1	.70	14	10.2	w.	34	sw.	7	4	8	18	7.4	6.2	3.4	0
Green Bay	617	5	32	992.9	1,016.3	−.6	30.8	−3.2	58	2	37	−1	30	25	24	1,023	24	78	1.84	−.3	.97	14	9.0	w.	30	se.	7	5	5	20	7.1	4.4	.2	0
Milwaukee[2]	681	33	66	990.9	1,016.3	−1.7	32.6	−3.3	55	5	38	−4	30	27	25	968	26	78	2.82	+1.0	.95	15	13.5	w.	48	sw.	7	7	5	18	6.8	9.0	4.0	0
Duluth[4]	1,133	5	47	972.2	1,015.2	−1.7	24.2	−5.8	47	5	30	−4	29	19	28	1,223	20	94	2.92	+1.5	1.35	14	12.5	w.	43	nw.	7	3	10	17	7.4	9.4	3.4	0
NORTH DAKOTA																																		
							22.2	−4.7										86	1.22	+.5											6.2			
Fargo[2]	940	5	47	980.4	1,016.3	−2.0	22.2	−4.9	51	3	30	−19	29	15	30	1,284	20	89	2.01	+1.1	.49	16	12.0	w.	34	nw.	8	3	4	23	8.0	19.0	14.6	0
Bismarck[2]	1,677	5	41	954.3	1,016.9	−2.4	23.5	−3.0	58	2	33	−4	24	14	41	1,244	19	84	1.00	+.4	.51	12	11.4	nw.	52	nw.	24	2	8	20	8.1	14.4	4.2	0
Devils Lake	1,478	11	44	960.7	1,016.6	−1.4	21.5	−3.0	54	2	28	−10	29	14	34	1,306	18	85	.97	+.2	.44	17	9.0	w.	26	nw.	7	3	7	20	7.9	10.5	7.5	0
Grand Forks[2]	832	4	41	985.1	1,016.9	−1.1	20.0	------	51	2	28	−18	29	12	30	1,352	18	88	1.35	------	.44	16	----	nw.	--	------	--	3	3	24	----	14.8	10.0	0
Williston	1,878	42	50	946.8	1,016.3	−2.3	24.0	−3.2	63	1	32	−1	18	16	34	1,229	20	86	.76	+.2	.22	13	7.2	nw.	25	nw.	24	6	8	16	6.9	7.7	1.2	0
UPPER MISSISSIPPI																																		
							34.4	−3.6										82	2.15	+.1											7.4			
Minneapolis-St. Paul[2]	919	43	74	981.0	1,016.3	−1.0	26.6	−5.8	61	3	33	−9	29	20	38	1,152	23	86	2.85	+1.6	.98	18	10.8	w.	43	w.	7	2	7	21	7.8	21.8	4.4	0
La Crosse[2]	714	5	29	989.2	1,016.3	−1.7	29.0	−4.7	56	1	36	−16	29	22	42	1,082	24	84	1.61	.0	.54	14	9.3	w.	37	w.	7	3	4	23	7.8	11.4	5.0	1
Madison[2]	974	27	39	980.0	1,016.6	−1.7	30.6	−3.6	62	2	37	−11	30	24	33	1,036	25	83	2.53	+.8	.63	15	11.0	w.	47	se.	7	7	3	20	7.1	15.5	8.3	1
Charles City	1,015	10	51	979.0	1,017.3	−1.3	29.8	−3.2	59	3	37	−3	30	22	34	1,052	----	----	1.98	+.4	1.00	18	6.7	nw.	25	nw.	7	6	6	18	7.2	10.4	3.4	1
Moline[2]	606	6	50	994.2	1,017.6	−1.4	33.8	−3.7	61	3	41	3	30	27	27	932	28	80	1.92	+.1	.51	11	10.2	w.	39	sw.	7	2	7	21	7.9	7.7	.6	2
Des Moines[4]	860	5	99	------	1,017.3	−1.3	34.6	−3.8	60	3	41	12	29	28	29	914	----	----	1.46	−.1	.72	9	10.3	w.	28	w.	8	4	6	20	7.5	4.9	.0	6
Dubuque	699	60	79	990.5	1,016.9	−1.7	32.4	−4.6	59	3	38	−1	30	26	28	981	26	78	1.84	+.1	.86	15	5.9	nw.	18	se.	7	3	10	17	7.4	10.2	2.8	1
Burlington[2]	702	4	36	990.9	1,017.3	−1.7	34.6	−4.0	61	3	42	7	30	27	28	913	30	84	1.89	−.2	.57	11	10.8	w.	34	w.	7	3	4	23	7.6	2.6	.0	1
Cairo	357	5	99	1,004.4	1,017.6	−3.1	45.6	−1.7	65	6	52	22	30	39	26	584	----	----	3.77	+.1	1.18	15	8.6	ne.	23	sw.	7	6	7	17	7.0	T	.0	2
Peoria[2]	609	7	26	994.2	1,017.3	−2.3	35.0	−1.5	61	4	42	3	30	28	28	895	28	78	2.54	+.2	.76	12	10.2	w.	36	sw.	7	4	6	20	7.5	3.6	.2	1
Springfield, Ill.[4]	636	5	191	993.6	1,017.6	−1.7	39.0	−3.2	61	4	45	12	30	33	21	780	32	81	.98	−1.5	.25	12	11.5	s.	30	w.	24	5	6	19	7.4	.3	.0	0
St. Louis[4]	568	33	59	996.3	1,017.3	------	41.6	−3.8	62	6	48	16	30	35	23	702	34	79	2.43	−.4	1.12	15	11.6	s.	33	s.	24	4	7	19	6.5	.5	.0	0
MISSOURI VALLEY																																		
							36.2	−3.9										80	1.75	+.2											7.0			
Columbia, Mo.[4]	784	6	66	988.2	1,017.3	−2.3	41.0	−3.1	67	6	48	16	30	34	28	721	30	74	1.65	−.6	.62	13	7.5	w.	22	sw.	7	6	5	19	7.2	.1	.0	0
Kansas City[2]	963	38	76	989.5	1,017.3	−2.3	40.0	−3.7	67	6	47	21	30	34	----	749	----	----	1.60	−.6	.73	9	10.5	ne.	34	nw.	27	7	6	17	6.8	T	.0	2
St. Joseph[2]	967	5	51	981.4	1,017.6	−1.7	38.0	−3.5	64	6	45	17	30	31	31	811	30	78	2.62	+1.0	.99	10	8.2	w.	26	w.	27	7	6	17	6.9	2.2	.0	2
Springfield, Mo.[2]	1,324	5	50	968.8	1,016.9	−3.1	41.9	−3.1	66	6	50	18	30	34	28	696	34	80	1.68	−1.1	.48	13	12.2	w.	37	s.	6	5	10	15	7.0	.4	.0	1
Topeka[4]	987	65	87	981.0	1,017.6	−1.7	39.7	−3.1	66	6	46	20	24	33	26	755	32	78	1.28	−.2	.46	9	8.6	w.	25	nw.	27	8	7	15	6.4	1.5	.0	2
Lincoln[4]	1,189	6	81	973.2	1,017.3	−2.0	36.0	−3.1	59	6	43	13	22	29	28	870	28	80	1.15	+.1	.50	8	9.8	nw.	28	w.	4	7	4	19	7.1	4.7	.0	0
Omaha[2]	1,105	5	68	976.6	1,017.6	−1.7	35.4	−2.9	60	6	42	13	23	29	28	886	28	78	1.23	+.2	.46	10	11.7	n.	34	n.	25	7	5	18	6.9	7.9	.0	0
Valentine	2,598	46	54	922.8	1,017.6	−2.0	27.8	−6.8	57	30	37	−5	22	19	42	1,114	24	84	1.51	+1.0	.52	9	9.1	w.	28	nw.	23	7	9	14	6.6	13.5	.1	0
Huron[2]	1,301	5	41	968.5	1,017.3	−2.0	25.8	−5.7	51	1	35	−6	29	17	42	1,179	22	92	3.01	+2.4	.79	14	11.9	nw.	42	nw.	24	3	5	22	8.0	28.2	4.5	0
NORTHERN SLOPE																																		
							29.3	−3.8										79	1.14	+.6											7.1			
Billings[2]	3,570	16	39	890.3	1,017.3	−3.4	30.9	−4.5	68	1	38	4	22	24	29	1,025	24	74	.63	------	.30	11	11.3	sw.	32	nw.	7	3	8	19	7.4	9.3	.0	0
Havre	2,507	11	67	926.5	1,018.3	−1.0	27.4	−3.8	71	1	36	−2	22	19	38	1,129	21	77	.38	−.2	.17	6	7.4	sw.	28	sw.	23	3	5	22	8.0	4.9	.0	0
Helena[2]	4,124	5	43	873.4	1,020.0	−.7	27.8	−4.0	67	1	36	−7	22	19	34	1,117	24	84	1.40	+1.0	.66	15	6.8	w.	29	w.	7	2	3	25	8.0	13.4	T	0
Missoula[2]	3,205	4	32	903.5	1,021.0	+.3	30.2	−1.2	60	1	36	9	21	25	23	1,050	27	90	2.41	+1.5	.45	17	4.4	se.	26	nw.	1	1	2	27	9.0	17.7	1.0	0
Kalispell	2,973	48	56	913.0	1,019.0	−1.7	31.2	−1.2	56	1	36	15	21	26	24	1,014	27	82	1.22	−.1	.38	15	4.2	w.	16	n.	8	1	5	24	8.4	13.2	.3	0
Miles City[2]	2,371	5	28	931.3	1,018.0	−2.7	29.2	------	68	1	39	0	22	20	34	1,072	21	74	.31	------	.09	8	----	nw.	--	------	--	6	9	15	6.7	2.8	.0	0
Rapid City[2]	3,259	5	56	899.8	1,017.3	−3.0	28.3	−6.3	64	2	39	−7	22	18	35	1,103	20	78	.76	+.3	.29	10	14.6	nw.	55	nw.	23	9	6	15	6.1	8.1	.0	0
Cheyenne[2]	6,094	22	40	809.3	1,017.3	−2.3	28.8	−6.0	57	1	39	−6	22	19	33	1,084	20	73	.78	+.3	.31	10	12.1	nw.	40	w.	11	8	16	6	5.1	10.0	T	0
Lander[2]	5,352	6	30	833.1	1,018.3	−3.7	26.6	−3.7	57	1	37	−5	22	16	31	1,153	18	76	.89	+.3	.31	9	3.9	se.	30	w.	8	7	11	12	6.0	13.3	.8	0
Sheridan[2]	3,790	5	38	883.2	1,018.6	−1.7	27.6	−5.1	71	1	37	−10	22	18	42	1,121	22	85	2.13	+1.5	.51	18	7.5	nw.	45	nw.	23	7	6	17	6.9	23.9	T	0
North Platte[4]	2,821	11	51	915.3	1,016.6	−3.4	34.0	−2.6	61	30	43	9	22	24	40	933	26	81	1.60	+1.1	.57	9	7.0	nw.	24	n.	6	7	7	16	6.6	5.2	.0	0

See footnotes at end of table.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR NOVEMBER 1947—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Thermometer above ground	Anemometer above ground	Pressure: Station	Sea level	Departure from normal	Temperature of the air: Mean	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Total degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Wind: Average hourly velocity	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month	Number of days with thunderstorms
	Ft.	Ft.	Ft.	Mb.	Mb.	Mb.	°F	°F	°F		°F	°F		°F	°F		°F	%	In.	In.	In.		Mi.								0-10	In.	In.	
MIDDLE SLOPE							39.9	−3.6										73	1.14	0.0											5.6			
Denver [4]	5,292	106	113	835.1	1,015.9	−3.1	34.9	−4.9	67	1	45	8	22	25	34	903	21	67	.57	.0	.21	8	7.1	s.	26	w.	7	13	10	7	4.9	7.5	.0	0
Pueblo [2]	4,690	5	36	854.4	1,016.3	−3.3	34.4	−3.9	60	26	49	7	22	20	51	917	22	68	.42	+.1	.31	5	6.4	nw.	38	n.	6	14	8	8	4.6	1.7	.0	0
Concordia	1,392	50	58	966.5	1,017.3	−2.7	37.8	−3.6	59	5	45	10	22	30	37	815	29	75	.98	.0	.59	7	8.1	se.	26	nw.	6	8	6	16	6.2	3.3	.0	0
Dodge City [2]	2,509	5	58	927.2	1,016.9	−3.1	37.4	−5.2	65	5	47	5	22	28	42	826	30	78	1.37	+.6	.76	7	15.2	se.	34	nw.	6	10	6	14	6.1	5.3	.0	0
Wichita [2]	1,358	52	64	967.5	1,018.3	−1.0	41.6	−3.2	64	5	50	22	23	34	29	703	32	72	.89	−.5	.46	7	13.4	nw.	40	nw.	6	13	3	14	5.6	T	.0	1
Oklahoma City [4]	1,214	10	47	973.2	1,017.3	−2.7	46.6	−2.2	71	6	55	25	11	38	34	554	36	74	1.68	−.2	1.00	8	8.2	s.	23	nw.	6	11	5	14	5.8	.0	.0	1
Tulsa [2]	674	10	60	992.2	1,016.9	----	46.4	−2.5	69	6	55	23	30	37	31	562	37	76	2.06	.0	1.00	9	10.3	nw.	38	w.	6	12	2	16	5.7	T	.0	2
SOUTHERN SLOPE							48.4	−2.0										66	1.22	−.2											5.2			
Abilene [2]	1,738	4	59	954.3	1,015.9	−3.7	50.1	−2.5	79	5	59	32	28	41	35	448	38	70	1.24	−.1	.55	7	13.2	s.	44	s	9	11	8	11	5.4	T	.0	0
Amarillo [2]	3,676	5	42	888.1	1,016.0	−3.3	40.8	−3.0	73	5	54	17	7	28	41	727	28	70	.92	.0	.70	5	13.9	s.	33	w.	23	10	10	10	5.2	T	.0	0
Del Rio	960	63	71	981.4	1,015.2	−3.8	59.0	−1.0	86	10	69	36	8	49	35	203	44	65	1.81	+.6	1.37	6	7.9	se.	35	n.	10	13	7	10	5.2	.0	.0	1
Roswell	3,566	75	85	890.6	1,015.6	−3.4	43.8	−1.3	76	5	58	18	11	30	49	632	25	58	.93	+.1	.43	6	8.6	n.	34	w.	14	11	9	10	5.2	.0	.0	0
SOUTHERN PLATEAU							48.8	−3.1										52	.53	−.2											4.3			
El Paso [2]	3,778	36	85	885.5	1,014.2	−3.8	49.4	−1.7	79	2	61	26	8	38	38	473	28	50	.53	.0	.34	5	10.7	n.	42	w.	6	13	9	8	4.5	.0	.0	0
Albuquerque [2]	4,972	45	45	846.9	1,014.6	−4.0	40.5	−2.8	73	2	52	20	22	29	37	734	22	53	.45	.0	.30	6	8.7	n.	40	nw.	6	10	15	5	4.8	5.7	.0	0
Flagstaff	6,907	34	48	788.7	1,018.3	----	32.8	−4.4	71	1	46	8	7	19	49	966	18	63	.88	−.4	.42	9	----	w.	--	----	--	14	8	8	4.4	12.0	.0	0
Phoenix [4]	1,107	39	87	975.3	1,014.9	----	56.6	−3.1	92	1	69	34	7	44	39	262	35	55	.60	−.1	.24	4	5.8	e.	18	e.	28	18	4	8	3.6	.0	.0	0
Tucson [2]	2,555	5	39	925.2	1,014.2	−.7	54.2	−3.5	90	1	67	28	7	41	41	337	32	49	.70	−.1	.33	5	----	se.	--	----	--	13	8	9	4.6	.0	.0	1
Yuma	142	9	54	1,009.5	1,014.6	−1.7	59.2	−3.2	90	1	72	35	23	46	37	186	33	41	T	−.3	T	0	5.6	n.	24	nw.	10	16	8	6	3.7	.0	.0	0
MIDDLE PLATEAU							33.7	−4.9										73	1.00	+.3											6.8			
Reno [2]	4,527	20	52	864.9	1,021.3	+.3	35.5	−4.2	64	1	51	8	22	20	43	884	24	66	.06	−.6	.05	2	5.8	s.	43	w.	1	5	11	14	6.6	3.0	.0	0
Winnemucca	4,339	5	56	870.3	1,021.3	+1.1	33.1	−5.3	72	1	44	−8	22	22	41	955	27	76	1.67	+1.0	.57	10	7.0	sw.	31	nw.	8	3	10	17	7.1	11.3	.0	1
Modena	5,473	10	46	----	----	----	30.0	−6.4	68	1	43	0	22	17	40	1,052	----	---	.71	+.1	.44	6	7.6	w.	30	sw.	2	12	4	14	5.7	10.0	.0	0
Salt Lake City [3]	4,357	32	58	867.9	1,019.3	−2.0	35.5	−3.9	72	1	42	16	6	29	32	885	29	79	1.88	+.7	.51	13	7.5	se.	30	se.	2	3	6	21	7.7	11.4	.0	0
Grand Junction [3]	4,602	5	26	859.5	1,019.0	−.6	34.5	−4.8	69	2	44	12	23	25	31	915	24	70	.69	+.1	.37	7	6.0	e.	32	s.	2	5	8	17	6.8	7.1	T	0
NORTHERN PLATEAU							36.8	−1.5										81	1.44	.6											8.0			
Baker [4]	3,471	36	54	898.1	1,021.7	−.7	34.0	−2.0	60	1	41	11	22	27	21	929	28	81	1.33	+.3	.36	15	4.9	se.	22	n.	2	0	7	23	8.4	11.0	.0	0
Boise [3]	2,739	5	49	923.1	1,021.0	−2.0	36.1	−3.6	73	1	44	17	22	29	30	864	31	82	1.27	.0	.36	12	8.7	se.	33	nw.	2	4	7	19	7.4	6.2	.0	0
Pocatello [2]	4,478	5	31	863.9	1,020.7	−1.3	32.6	−1.5	70	1	39	16	21	26	43	975	26	79	1.32	+.3	.45	15	10.0	sw.	33	sw.	8	3	6	21	7.7	8.6	.0	0
Spokane [2]	1,929	6	51	949.9	1,020.3	−1.0	34.8	−3.7	52	1	41	18	22	29	18	907	31	85	1.67	−.4	.43	15	4.4	ne.	23	nw.	8	0	6	24	8.9	5.8	.0	1
Walla Walla	991	57	65	984.8	1,021.7	+.4	42.6	−.2	59	25	48	27	22	38	----	670	----	---	2.30	+.3	.75	16	4.6	s.	25	w.	10	0	4	26	8.7	T	.0	1
Yakima [2]	1,076	4	54	981.0	1,021.0	−.3	40.4	+2.3	61	10	51	23	23	30	33	739	32	78	.73	−.5	.32	8	----	w.	--	----	--	6	6	18	6.9	1.1	.0	0
NORTH PACIFIC COAST							46.4	+.4										85	3.75	−2.7											7.9			
North Head	211	5	55	1,013.2	1,021.0	+3.0	47.8	−.4	60	27	52	36	21	43	15	518	44	86	6.49	−2.0	.99	23	12.5	nw.	35	nw.	13	5	7	18	7.2	.0	.0	0
Seattle [4]	125	90	321	1,016.6	1,021.3	+2.7	45.9	−.9	58	1	50	33	23	42	13	572	42	88	3.66	−1.4	.85	22	7.0	se.	24	s.	6	0	7	23	8.6	.0	.0	1
Tacoma	194	172	201	1,013.9	1,021.0	+2.7	44.7	+.1	58	1	49	31	23	40	14	613	----	---	2.91	−3.4	.84	19	7.3	s.	34	sw.	10	1	10	19	8.3	.0	.0	0
Tatoosh Island	86	5	61	1,017.6	1,021.0	+3.4	46.4	+.5	55	1	50	37	22	43	12	557	42	86	5.05	−6.9	.90	20	14.7	e.	49	e.	14	5	8	17	7.0	.0	.0	0
Medford [2]	1,329	29	58	974.6	1,023.4	+2.4	43.8	−.1	64	25	52	24	23	36	30	637	39	84	1.99	−.4	.74	14	----	n.	--	----	--	3	5	22	7.8	.0	.0	0
Portland, Oreg. [4]	154	68	106	1,016.3	1,022.0	+2.4	48.4	+1.6	62	7	53	32	23	44	16	498	42	84	3.31	−2.8	1.28	22	4.8	nw.	17	sw.	6	3	4	23	8.1	.0	.0	0
Roseburg	510	45	76	1,004.1	1,023.0	+2.7	47.8	+1.9	69	25	54	28	23	42	27	512	43	84	2.82	−1.8	1.05	17	3.0	n.	14	sw.	4	1	4	25	8.2	.0	.0	0
MIDDLE PACIFIC COAST							51.8	−1.9										72	1.26	−1.9											4.9			
Eureka	60	72	88	1,021.0	1,023.4	+3.1	49.0	−2.1	65	26	55	35	22	43	21	478	44	82	1.72	−3.5	1.17	8	6.2	n.	24	n.	9	10	8	12	5.7	.0	.0	0
Red Bluff [2]	353	5	26	1,007.1	1,020.0	----	52.0	−1.8	72	26	63	31	24	41	34	390	36	60	.89	−2.1	.70	5	6.9	nw.	25	w.	4	15	5	10	4.8	.0	.0	0
Sacramento [4]	66	92	115	1,016.9	1,019.3	0	51.0	−2.6	68	27	61	31	23	41	26	419	39	70	1.02	−.9	.67	4	6.6	n.	23	sw.	9	14	10	6	4.5	.0	.0	0
San Francisco [4]	155	112	132	1,014.2	1,020.0	+.7	55.3	−1.0	69	26	61	43	23	49	19	291	42	74	1.39	−1.0	1.00	3	6.7	w.	29	w.	1	13	9	8	4.6	.0	.0	0
SOUTH PACIFIC COAST							56.0	−1.5										63	.40	−.5											4.3			
Fresno [2]	327	5	34	1,006.8	1,019.3	−.3	50.6	−1.8	76	29	64	27	23	37	36	435	37	66	.43	−.5	.30	4	4.0	nw.	31	nw.	5	11	11	8	4.9	.0	.0	0
Los Angeles	338	236	263	1,004.1	1,016.6	−1.0	59.0	−1.9	82	26	69	43	23	49	30	182	40	56	.06	−1.1	.04	3	7.0	w.	34	nw.	5	14	12	4	3.8	.0	.0	1
San Diego [2]	87	20	55	1,013.2	1,016.3	−.6	58.4	−.9	76	26	68	40	23	49	28	198	46	68	.72	.0	.59	3	6.1	ne.	23	sw.	9	12	10	8	4.2	.0	.0	1
WEST INDIES																																		
San Juan, P. R.	82	9	54	1,010.5	1,013.2	----	78.9	+.5	90	1	83	71	30	74	14	0	72	80	2.62	−4.2	.96	15	9.8	e.	34	ne.	23	4	17	9	5.9	.0	.0	1
PANAMA CANAL																																		
Balboa Heights [6]	118	6	92	----	----	----	79.4	----	90	4	86	69	29	73	----	----	----	---	10.25	----	3.10	24	4.2	nw.	19	n.	18	0	11	19	----	.0	.0	14
Cristobal [6]	27	37	92	----	----	----	80.0	----	88	27	85	72	29	75	----	----	----	---	12.43	----	2.46	23	5.7	s.	23	nw.	19	5	7	18	----	.0	.0	12
ALASKA																																		
Anchorage [2]	132	6	44	1,000.7	1,005.8	----	27.6	+5.2	52	22	34	4	15	22	23	1,126	24	88	1.23	+0.1	.29	11	5.0	n.	19	se.	24	1	0	29	9.1	11.5	2.2	0
Fairbanks [2]	4	5	63	992.2	1,010.2	----	12.3	+8.9	47	22	17	−20	17	7	31	1,680	8	90	.66	.0	.20	9	4.0	nw.	17	sw.	12	5	9	16	7.0	10.6	8.9	0
Juneau [2]	80	6	30	1,010.8	1,013.9	----	37.4	+4.1	47	22	41	21	20	34	16	827	34	87	4.89	−1.8	.64	26	10.0	e.	33	se.	12	0	2	28	9.6	6.7	.0	0
Nome [2]	22	10	75	1,004.8	1,005.4	----	17.6	+1.7	44	23	25	−12	11	10	27	1,424	16	90	1.49	+.5	.46	15	14.0	e.	45	ne.	21	8	3	19	6.5	10.1	5.3	0
Barrow	29	5	27	1,020.0	1,020.0	----	4.6	+4.6	25	30	10	−12	26	0	24	1,824	4	93	.16	.0	.04	9	14.0	ne.	36	e.	22	1	5	24	8.2	3.5	12.5	0
Bethel [2]	28	5	31	999.9	1,001.4	----	21.6	+4.9	45	21	28	−5	16	16	33	1,300	22	94	1.32	+.4	.32	19	11.0	ne.	38	----	11	2	6	22	8.0	9.2	.7	0
Cordova [2]	45	5	32	1,004.2	1,006.1	----	36.2	+6.7	49	1	42	14	5	30	24	863	36	94	15.17	+6.6	3.97	25	----	e.	--	----	--	0	2	28	9.3	2.1	.0	0
Galena	139	4	66	1,002.0	1,006.8	----	10.2	----	34	21	16	−26	17	4	23	1,652	6	76	.78	----	.20	15	----	n.	40	e.	27	1	10	19	8.0	9.4	5.4	0
Gambell	32	5	32	1,005.1	1,006.4	----	19.2	−3.3	35	1	22	6	10	16	12	1,474	18	92	.70	−.2	----	10	25.0	ne.	51	ne.	26	0	5	25	9.9	3.8	2.5	----
Ketchikan	25	69	90	1,016.3	1,016.9	----	41.1	+.9	50	28	45	29	15	37	13	715	39	92	12.41	−7.8	2.27	26	6.0	ne.	24	se.	11	0	2	28	9.0	T	.0	0
Kotzebue [2]	20	5	31	1,009.1	1,009.5	----	12.4	+6.6	35	22	18	−13	15	7	25	1,569	10	84	.80	+.5	----	13	13.0	se.	38	e.	27	7	4	19	6.9	7.6	8.4	----
McGrath [2]	341	5	31	994.6	1,007.8	----	9.2	+6.8	41	22	18	−27	17	1	35	1,671	9	89	1.46	+.4	.85	14	----	nw.	22	ne.	23	1	5	24	8.5	19.7	10.5	0
Northway [2]	1,718	5	32	947.2	1,012.9	----	7.2	+9.5	23	24	14	−20	19	1	26	1,735	6	90	.51	+.2	.20	10	24.0	e.	29	w,nw.	10	0	5	25	8.8	5.5	11.1	0
HAWAII																																		
Honolulu	38	86	98	1,014.2	1,015.6	----	75.9	+1.4	82	10	80	68	28	71	12	0	68	74	1.14	−2.7	.41	10	7.1	ne.	20	e.	30	11	13	6	4.9	0.0	.0	0

[1] Height of barometer cistern above mean sea level on January 1, 1900, or when station was first established since January 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevation according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records; remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport; remainder from city office records.

[6] Bihourly hygrometric data.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE LOCAL STORMS FOR NOVEMBER 1947

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Atlanta, Ga.	1	Late afternoon				High winds	Peak gusts of 62 m. p. h. Power lines and trees blown down; windows broken, mostly by flying fragments. Power failures in several parts of city. 1 person injured by portion of tin roof blown off building.
N. C. Coast, Hatteras to Wilmington.	1-2	P. m.-a. m.				Northeast storm	Winds of 55 m. p. h. recorded in Morehead City area; exceptionally high tides. Most damage caused by grounding of boats. 1 yacht, valued at $20,000, a total loss. 2 miles of highway washed out.
DeQuincy, La., 1½ miles southeast.	6	1:30 p. m.		0	$4,000	Small tornado	A series of tornadoes struck in northwest, southwest, and southeast sections of State. At DeQuincy 1 home and garage destroyed.
Pine Island and Nederland, Tex.	6	Late afternoon	200	0	20,000	Tornado	Damaged buildings; injured 3 persons.
Cleburne, Tex.	6	5:30 p. m.	[1] 2			Hail	Principal damage to buildings and automobiles.
Hackberry to Lake Charles, La.	6	6:30 p. m.	175	0	25,000	Tornado and high winds.	Tornado, which struck oil fields near Hackberry, evidently dissipated into high winds of 66 m. p. h., at Lake Charles; apparently not the one which struck Orange, Tex., during evening of 6th. Moved northeastward. At Hackberry, 3 oil derricks and several houses destroyed; at Lake Charles, damage minor.
Converse to Winnfield, La.	6-7	7:30 p. m.-1 a. m.		1	20,000	Tornado	Tornado first reported 2½ miles north of Converse; may have moved into Louisiana from Texas; passed over mostly low timberlands and State forests to vicinity of Winnfield. 2 persons injured; 2 farmhouses destroyed; damage mostly to timber.
Galiano to New Orleans, La.	6-7	10 p. m.-5 a. m.	170	3	50,000	Tornado and high winds.	Tornado at Galiano, LaFourche Parish, injured 10 persons. Movement toward northeast. After passing over Galiano it decreased into squalls and high winds which uprooted trees in New Orleans.
Minnesota, southwestern, central, and northeastern.	6-7			1	1,200,000	Sleet, snow, and wind.	Many poles, wires, and power lines down, seriously disrupting communication and electric services. Traffic of all kinds delayed. Side roads on Iron Range blocked by snowdrifts. Branches of trees broken off. High winds demolished a 300-ft. coal conveyor on Duluth dock, killing 1 person and injuring 2.
Orange, Tex.	7	1:30 a. m.			25,000	Wind	Demolished or damaged buildings; slightly injured 1 person.
Jennings, La.	7	2:35 a. m.			2,000	High winds	Apparently not a tornado but may have been preceded by tornado over swamplands to southwest. Moved northeastward. A few barns wrecked and communications lines down.
Narragansett Bay area, R. I., and Nantucket County, Mass.	8	Noon to 10 p. m.		1	75,000	Southeast gale and high tides.	Heavy damage to small craft and waterfront property. Many communities in southern and central Rhode Island without electric lights and power; streets and highways impassable for several hours due to high water and wind damage. At Cranston, R. I., a man electrocuted. On western end of Nantucket Island a residence and 6 bathhouses swept in the sea by heavy surf and high tide.
Ebro, Fla.	11	4 a. m.		0	25,000	Tornado	A dozen or more dwellings suffered major damage. 8 persons injured.
Elgin Field, Fla.	11	4 a. m.		0	75,000	do	2 temporary barracks wrecked; 30 to 40 motor vehicles damaged by falling trees; 3 C-47 transport planes damaged; numerous buildings damaged to varying degrees. 13 soldiers injured, 2 seriously.
Fort Walton, Fla.	11	A. m.			10,000	Wind squalls with passage of cold front.	Damage principally to communication lines, trees, and roofs.
Niceville, Fla.	11	A. m.			2,000	do	Do.
Sunnyside Beach, Fla.	11	A. m.			10,000	do	Do.
Tallahassee, Fla.	11	A. m.			5,000	do	Do.
Perry, Fla.	11	3:30 p. m.	100	0	500	Tornado	Moved northeastward. Damage to roofs and telephone lines.
Port St. Joe, Fla.	11				1,000	High tides	Washed out section of highway.
Nantucket, Dukes, and Barnstable Cos., Mass.	12	8 a. m.-midnight.			1,000,000	Gales, high tides, and heavy rain.	Wind velocities of hurricane force and shifting in direction from southeast to northwest, caused localized damage as severe as experienced during the tropical hurricanes of 1938 and 1944. At Nantucket, Mass., 5 newly constructed 300-foot towers of Civil Aeronautics Authority blown over and destroyed; small houses unroofed, chimneys toppled, and considerable other minor damage. Total estimated property damage $100,000. On Marthas Vineyard Island, a hangar at airport collapsed, seriously damaging 15 stored airplanes. Widespread damage to buildings, waterfront property and small craft; light, power, and telephone service disrupted over much of the Island. Damage to Government installations, public utilities, and private property on Cape Cod from Provincetown to Cape Cod Canal; highways blocked by debris; power, light, and telephone service broken down for 12 to 48 hours in some areas. Damage particularly severe in Provincetown area, where heavy rains, high tides, and winds of hurricane force destroyed shore and harbor property estimated at $100,000. In Boston area some interruption of power and telephone service.
Rhode Island	12	do				do	Small pleasure and fishing boats beached and damaged along coast. Highways and railroad tracks flooded by heavy rains and high tides, resulting in serious traffic delays. Streets flooded in Providence and many towns throughout State; numerous reports of power and telephone failures.
Liberty, Tex.	14	11 a. m.	880	0	1,000	Tornado	Damaged buildings slightly and injured 3 persons in Hardin Community.
DeRidder to near Alexandria and Colfax, La.	14	12:30-2:30 p. m.	50	0	500,000	Tornado and high winds.	Storm moved northeastward. 20 persons injured; 30 homes or stores destroyed; 50 others seriously damaged.
Pensacola, Fla.	14	11:45 p. m.	35	0	100,000	Tornado	First struck on water front, doing major damage to a railroad wharf, then extended its path of damage northeastward through warehouse district.
South Dakota, eastern two-thirds of.	14-20					High winds and heavy snow.	Travel by rail, plane, and car very hazardous; many schedules delayed or cancelled; power and telephone lines damaged severely.
Uniontown, Pa.	15	Morning				Wind	Damage to roofs, windows, telephone and telegraph wires.
Racine and Milwaukee, Wis.	15	Forenoon			50,000	Wind and waves	At Racine 50-mile wind caused 10- to 15-foot waves inside breakwater; washed away a revetment at Coast Guard Station. At Milwaukee waves 25- to 30-feet high broke over breakwater; much debris washed ashore and shore lights broken; winds up to 42 m. p. h., broke plate glass windows and downed power lines.
Albany, Ga., 6 miles south of.	15	Afternoon	30	0	600	Tornado	Traveled about ½ mile on ground. 1 barn completely demolished, with feedstuff ruined; 2 other barns heavily damaged; a pecan tree uprooted.
Falfurrias, Tex.	17	5:10 a. m.				Hail and wind	Slight damage to citrus orchards.
Uvalde, Tex.	17	7 a. m.	50		1,000	Wind	Slight damage to buildings at Southwest Texas Junior College.
Laredo, Tex.	22				30,000	Hail and wind	Destroyed about 60 acres of tomatoes.
Key West and Sombrero Light, Fla.	28	Noon-3 p. m.			25,000	Tropical storm	Storm of small diameter moved east-northeastward through the Florida Keys with winds up to 58 m. p. h. at Key West and 75-80 m. p. h. at Sombrero Light. Damage to small boats, wire lines, roofs, and windows.

[1] Miles instead of yards.

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LATE STORM REPORTS FOR AUGUST–OCTOBER 1947

[The table hereunder contains such data as were received concerning severe local storms that occurred during these months. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
	Aug.						
Port Isabel, Tex.	1–2	9:30 p. m.–8:30 a. m.				Tropical disturbance.	Preliminary estimate of damage to cotton crop, about $2,000,000, caused by heavy rain; probably more than offset by improved moisture conditions for ranges, late feed crops, citrus fruit, and fall vegetables. Strongest wind reported, 44 m. p. h., at Port Isabel.
Grand Isle, La.	22	All day				do.	Minor disturbance. Strongest wind reported, 44 m. p. h., at Grand Isle.
Galveston, Tex., and vicinity.	24–25	5:45 p. m.–1:15 a. m.		1	$382,500	do.	Damage in Galveston confined mainly to roofs, signs, plate glass windows, small shacks, garages, and interiors of dwellings by wind-driven rain. 1 man electrocuted. Crop damage $32,500.
	Sept.						
Mobile, Ala. to Biloxi, Miss.	8	Afternoon				do.	Gusts of 51 m. p. h., at Pensacola and up to 45 m. p. h., at Mobile. 2 ships went aground in Mobile Bay but were later refloated.
Louisville, Ky.	12	4:30 p. m.	[1] 1	3	200,000	Wind squall	
	Oct.						
Mt. Desert Island, Kennebunk and Waterboro, Maine.	21–28			5	3,000,000–5,000,000	Fire due to drought.	Almost unprecedented fire hazard due to serious drought that prevailed, almost unbroken, since Sept. 30, was responsible for, and greatly aggravated forest and grassland fires.
Gloucester, Mass., near.	23			1		do.	20 homes destroyed.
Maine, southern and eastern portions; New Hampshire, southern portion; Connecticut and Massachusetts, and scattered areas.	23–28					do.	
Ruston, La.	27	1 a. m.			25,000	Hail and high winds.	Most damage caused by winds; buildings damaged, trees uprooted, and telephone, telegraph, and electric wires down.
Penn Line, Pa.	28	9 p. m.				Electrical	Lightning struck and demolished attic of a home.

[1] Miles instead of yards.

SOLAR RADIATION AND SUNSPOT DATA FOR NOVEMBER 1947

[Solar Radiation Investigation Section, I. F. HAND in Charge]

Explanations of the tables and references to descriptions of instruments, stations, methods of observation, and summaries of data are given in the Monthly Weather Review, vol. 72, page 43, January 1944. A list of pyrheliometric stations is given on page 45 of the same Review. An explanation of the formula used in computing the air mass values for each station will be found in vol. 75, page 47, March 1947.

SOLAR RADIATION OBSERVATIONS

TABLE 1.—*Solar radiation intensities during November 1947*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
CLIMAX, COLO.											
	Air mass										
	3.24	2.59	1.94	1.29	*0.65	1.29	1.94	2.59	3.24		
November	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1						1.47	1.40	1.30	1.22		
2				1.60		1.56		1.28	1.20		
12			1.46	1.56							
13	1.26	1.38	1.48	1.60		1.56	1.44	1.32	1.20		
27							1.42				
28		1.40	1.50								
29			1.46				1.50	1.40	1.32		
Means	(1.26)	(1.39)	1.48	1.59		1.53	1.44	1.32	1.24		
Departures	.00	+.01	+.03	+.01		+.01	+.01	+.01	+.02		
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
November	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
1				1.50							
2				1.49							
4				1.52							
5				1.54							
6				1.50							
7				1.50							
10				1.50							
11				1.48							
13	1.18	1.27	1.38	1.50							
17	1.15	1.24	1.34	1.47							
18				1.49							
20				1.52							
23				1.52							
24				1.47							
25				1.47							
26	1.15	1.24	1.35	1.47							
Means	1.16	1.25	1.36	1.50							
Departures	+.01	+.01	+.01	.00							

TABLE 1.—*Solar radiation intensities during November 1947*—Con.

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
November	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
7				1.34		1.34	1.20	1.07	0.98	3.8	4.2
8	1.07	1.16	1.27	1.38		1.38	1.24			2.9	2.7
21			1.11							4.6	3.7
22	.81	.92	1.11							2.5	3.0
28	.90	.98	1.09				1.18	1.07	.96	4.2	6.1
Means	.93	1.02	1.14	(1.36)		(1.36)	1.21	(1.07)	(.97)		
Departures	.00	−.01	.00	.00		.00	.00	.00	.00		
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
November	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
2	0.92	1.03	1.15	1.30		1.32	1.18	1.06		7.0	5.7
9	.80	.91	1.00	1.22						4.8	4.3
10	.97	1.08	1.19				1.25	1.12	1.01	4.8	3.9
13	1.00	1.06	1.15							3.6	4.8
14	.88	1.00	1.10	1.34			1.23	1.07	.98	3.8	4.2
17	1.00	1.09		1.40			1.24			3.6	4.2
18	1.06	1.13	1.26			1.40	1.24	1.11	1.00	4.1	4.1
19	.95	1.08	1.22					1.00	.94	3.7	4.1
21	.88		1.06					1.00	.93	3.5	3.5
29	.84	1.00								3.3	2.9
30			1.10				1.04			3.2	3.0
Means	.93	1.04	1.14	1.32		1.36	1.20	1.06	.97		
Departures	.00	.00	−.02	+.01		.00	+.01	.00	.00		
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	39.6	4.96		
November	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
11	0.73	1.04	1.07							4.6	6.9
14	.70	.95	1.02	1.32		1.32	1.12			3.7	4.8
17	.92	.95		1.32				0.97	0.93	4.0	4.8
18	.88	1.00	1.10	1.24		1.24	1.16	1.03	.91	4.4	4.7
19	.72	.97	.69	1.24		1.24	.91	.76	.67	3.8	4.6
21	.71	.76	.81	.70		.70	.94	.81	.75	3.8	3.5
24	.71									5.5	9.1
Means	.77	.94	.94	1.16		1.12	1.03	.89	.82		
Departures	+.05	+.10	−.01	+.01		−.01	+.01	.00	+.02		
RATIO, BOSTON/BLUE HILL ON COMPARABLE DATES											
	0.78	0.79	0.67	(0.96)		(0.88)	(0.92)	0.84	0.81		

*Extrapolated.
[1] 75th meridian time.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface*

[Gram calories per square centimeter]

Date	Washington, D. C.	Lincoln, Nebr.	New York, N. Y.	Fresno, Calif.	Columbia, Mo.	Boston, Mass.	Nashville, Tenn.	Twin Falls, Idaho	La Jolla, Calif.	Riverside, Calif.	Blue Hill, Mass.	Newport, R. I.	Salt Lake City, Utah	Put-in-Bay, Ohio	State College, Pa.	Davis, Calif.	Toronto, Canada	Ithaca, N. Y.	Boulder, Colo.	East Wareham, Mass.	Honolulu, Hawaii	Pearl Harbor, Hawaii
1947	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Oct. 29	255	346	111	130	69	56	264	156	319	145	72	47	148	55	82	227	32	91	151	58	522	474
Oct. 30	190	30	31	334	198	14	307	224	322	359	44	64	274	216	82	252	39	15	236	35	464	415
Oct. 31	64	56	29	365	29	36	91	265	332	382	52	52	313	99	72	348	105	110	320	64	501	450
Nov. 1	187	98	257	199	84	88	52	276	271	343	94	105	341	260	324	214	260	221	298	86	512	480
Nov. 2	174	45	268	271	122	252	63	26	321	330	312	300	214	222	302	335	264	217	282	208	529	482
Nov. 3	11	66	117	362	56	243	97	276	334	377	235	230	80	72	64	345	235	179	64	240	459	440
Nov. 4	228	56	23	356	151	44	240	60	344	361	62	58	246	11	51	182	13	22	304	64	456	449
Means	158	100	119	288	101	105	159	184	320	328	124	123	231	133	140	272	135	122	237	108	492	456
Departures	−84	−129	−85	−36	−96	−41	−62	−25	−22	+14	−84	−90	−3	−55	−43	−17	−9	−35	−25	−95	------	------
Nov. 5	228	339	143	367	311	79	347	208	318	355	94	226	74	67	130	369	32	31	233	109	264	236
Nov. 6	164	232	26	347	215	44	248	151	308	375	54	88	133	98	124	348	78	24	183	47	305	250
Nov. 7	187	349	103	352	273	142	133	96	338	383	147	148	103	150	129	349	126	144	309	150	502	476
Nov. 8	177	344	20	337	359	15	322	87	211	328	57	44	300	240	240	334	234	30	317	78	474	388
Nov. 9	330	245	216	329	290	188	306	193	220	258	236	242	216	190	175	356	91	90	98	249	352	350
Nov. 10	280	100	275	327	33	247	72	90	323	359	288	291	88	146	259	333	163	189	297	283	448	315
Nov. 11	16	336	52	286	340	133	20	204	315	340	183	168	40	39	20	318	12	33	286	188	461	396
Means	197	278	119	335	260	121	207	147	290	343	151	172	136	133	154	344	105	77	246	158	401	344
Departures	−23	+54	−61	+43	+86	−13	+27	−55	−17	+42	−31	−25	−47	+5	+14	+74	−15	−53	−7	−5	------	------
Nov. 12	322	173	264	345	322	0	321	219	254	345	11	27	271	246	319	296	198	74	102	57	454	415
Nov. 13	286	92	229	284	144	225	149	109	299	333	266	252	225	156	266	202	231	138	276	264	354	272
Nov. 14	298	32	278	280	------	241	42	169	221	266	274	288	73	196	286	286	199	82	238	270	404	329
Nov. 15	32	124	82	95	------	232	205	104	144	140	257	191	42	6	54	27	47	66	269	236	480	428
Nov. 16	139	148	148	87	------	143	287	130	254	324	174	85	58	24	152	296	41	41	217	122	407	418
Nov. 17	161	82	190	259	------	234	269	108	296	329	262	275	198	244	99	158	83	35	228	262	403	326
Nov. 18	164	76	246	56	------	228	58	104	208	301	270	263	35	84	187	275	69	105	171	253	496	430
Means	200	104	207	201	------	186	190	135	239	291	216	197	129	137	195	220	184	77	215	209	428	374
Departures	−2	−103	+54	−42	------	+58	−18	−27	−45	+16	+52	+13	−20	−14	+25	−22	−16	−34	−23	+28	------	------
Nov. 19	260	52	223	143	------	198	50	99	234	252	259	255	120	107	261	313	151	168	44	211	432	423
Nov. 20	148	22	91	284	124	141	143	137	289	272	159	186	104	199	161	292	117	89	------	140	484	37
Nov. 21	237	218	214	269	49	194	156	101	280	274	250	254	200	144	201	290	159	141	179	242	464	423
Nov. 22	46	309	47	268	75	118	44	176	177	136	156	176	175	27	28	205	50	72	280	174	456	281
Nov. 23	123	226	71	280	44	74	103	207	304	318	91	63	151	157	182	270	146	79	148	45	365	296
Nov. 24	25	172	34	284	146	68	176	138	292	273	107	92	73	29	1	266	10	21	240	129	301	274
Nov. 25	231	201	153	265	210	98	250	198	273	263	174	157	150	73	89	263	88	19	155	91	380	234
Means	153	172	119	256	108	127	132	151	264	255	171	169	139	105	132	271	103	84	174	148	412	329
Departures	−32	−23	−21	+22	−52	+12	−41	−6	−22	−20	+20	+7	+6	−16	−4	+49	+3	−34	−34	−1	------	------
Nov. 26	157	68	138	270	19	117	218	130	270	267	196	200	24	93	86	236	181	------	231	203	473	417
Nov. 27	176	107	167	233	117	189	205	165	211	234	229	196	192	140	114	210	153	------	253	189	451	411
Nov. 28	144	258	132	134	230	46	234	157	230	171	57	71	147	133	56	150	201	71	202	65	460	420
Nov. 29	161	189	80	248	169	108	248	146	223	235	149	144	170	119	99	220	172	57	240	162	458	408
Nov. 30	193	251	183	131	301	148	278	85	91	231	210	432	106	221	191	87	206	138	85	208	481	418
Dec. 1	222	196	184	59	------	173	242	71	84	112	226	233	43	220	214	258	160	165	78	240	350	368
Dec. 2	215	82	141	202	------	93	260	122	241	227	136	198	70	50	115	276	24	25	3	182	404	391
Means	181	164	146	182	------	125	241	125	193	211	172	182	108	140	125	205	157	91	156	178	439	405
Departures	+14	−14	+17	−20	------	+25	+77	−18	−66	−42	+22	+25	−20	+32	−1	−30	+61	+1	−38	+35	------	------

ACCUMULATED DEPARTURES ON DECEMBER 2, 1947

	Washington, D. C.	Lincoln, Nebr.	New York, N. Y.	Fresno, Calif.	Columbia, Mo.	Boston, Mass.	Nashville, Tenn.	Twin Falls, Idaho	La Jolla, Calif.	Riverside, Calif.	Blue Hill, Mass.	Newport, R. I.	Salt Lake City, Utah	Put-in-Bay, Ohio	State College, Pa.	Davis, Calif.	Toronto, Canada	Ithaca, N. Y.	Boulder, Colo.	East Wareham, Mass.	Honolulu, Hawaii	Pearl Harbor, Hawaii
	+5,362	−1,897	−6,090	+7,679	------	+1,169	+672	−1,729	−7,651	+8,197	+847	−3,696	------	------	−5,789	+3,626	−1,568	------	−1,092	------	------	------

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR NOVEMBER 1947

NOTE: Publication of "Positions, Areas, and Counts of Sunspots" in the MONTHLY WEATHER REVIEW will be *discontinued* with the December 1947 issue. The data will be issued thereafter through publications of the U. S. Naval Observatory, at various times depending on the sunspot activity. Current data will be distributed monthly to a limited number of persons on request addressed to Superintendent, U. S. Naval Observatory, Washington 25, D. C.

By LUCY T. DAY

[Equatorial Division, U. S. Naval Observatory]

[Communicated by the Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day under Mount Wilson group number, longitude, latitude, area of spot or group, and spot count, are included respectively: number of groups, assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

Date	Eastern standard time		Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
				Difference in longitude	Longitude	Latitude	Distance from center of disk				
1947	h	m		°	°	°	°				
Nov. 1	11	20	8909	−35	173	−11	38	24	7	F	U. S. Naval.
			8909	−32	176	−10	35	145	10		
			8909	−27	181	−9	30	436	1		
			8912	−31	177	+11	32	12	3		
			8908	−16	192	+19	23	206	1		
			8911	0	208	−16	20	24	4		
			8907	+19	227	−16	27	97	1		
			8903	+29	237	−18	36	73	1		
			8901	+40	248	−10	42	194	1		
			8910	+40	248	+19	42	97	10		
			8897	+63	271	−4	64	121	1		
			8896	+70	278	−19	72	12	1		
			(10)		(208)	(+4)		1,441	41		
2	14	10	8909	−20	173	−11	25	24	6	F	Do.
			8909	−15	178	−10	21	97	4		
			8909	−12	181	−8	17	436	2		
			8908	−5	188	+20	17	12	1		
			8908	−1	192	+18	15	194	1		
			8907	+33	226	−16	38	73	1		
			8903	+44	237	−19	50	97	1		
			8910	+54	247	+17	55	73	2		
			8901	+55	248	−11	57	194	3		
			8897	+78	271	−4	78	97	1		
			(7)		(193)	(+4)		1,297	22		
3	10	15	8909	−8	174	−11	17	145	19	F	Mt. Wilson.
			8909	−2	180	−10	14	97	7		
			8909	0	182	−8	12	436	2		
			8914	−7	175	+26	23	36	5		
			8914	−4	178	+25	22	24	1		
			8908	+10	192	+19	18	194	1		
			8907	+46	228	−16	50	61	1		
			8903	+57	239	−18	61	61	1		
			8913	+50	232	+17	52	24	2		
			8901	+68	250	−11	69	109	1		
			(7)		(182)	(+4)		1,187	40		
4	10	47	8914	+6	174	+26	24	73	1	G	U. S. Naval.
			8914	+10	178	+25	24	48	7		
			8909	+9	177	−11	17	97	6		
			8909	+13	181	−9	19	436	3		
			8908	+23	191	+18	26	194	2		
			(*)	+33	201	+15	35	12	2		
			8915	+46	214	−16	50	24	2		
			8907	+58	226	−16	61	97	1		
			8903	+70	238	−18	72	48	1		
			8901	+82	250	−12	82	194	2		
			(8)		(168)	(+4)		1,223	27		
5	10	29	8917	−75	80	−10	75	24	1	F	Do.
			8916	−67	88	−21	70	24	1		
			8914	+18	173	+27	29	48	3		
			8914	+20	175	+26	29	48	1		
			8914	+23	178	+25	30	36	2		
			8909	+26	181	−9	29	388	2		
			8908	+37	192	+18	39	121	1		
			8915	+63	218	−18	66	48	5		
			8907	+72	227	−16	75	97	1		
			(7)		(155)	(+4)		834	17		

See footnotes at end of table.

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR NOVEMBER 1947—Continued

Date	Eastern standard time		Mount Wilson group No.	Heliographic				Area of spot or group	Spot count	Plate quality	Observatory
				Difference in longitude	Longitude	Latitude	Distance from center of disk				
1947	h	m		°	°	°	°				
Nov. 6	11	10	8919	−79	63	+20	79	388	1	F	U. S· Naval.
			8917	−62	80	−10	65	36	3		
			8916	−54	88	−21	58	6	1		
			8914	+30	172	+28	38	12	2		
			8914	+32	174	+26	38	48	2		
			8914	+38	180	+25	42	24	1		
			8909	+40	182	−10	42	291	5		
			8908	+50	192	+18	52	97	1		
			8918	+68	210	+23	68	36	2		
			8915	+78	220	−18	78	48	1		
			(8)		(142)	(+4)		986	19		
7	9	48	8922	−80	49	+7	80	194	1	P	Do.
			8919	−66	63	+20	66	291	2		
			8921	−57	72	+10	57	6	1		
			8917	−51	78	−10	53	48	1		
			8917	−47	82	−9	49	48	2		
			8920	+33	162	−15	38	24	2		
			8914	+45	174	+26	49	48	7		
			8909	+53	182	−10	55	291	3		
			8908	+63	192	+18	64	145	1		
			(8)		(129)	(+4)		1,095	20		
8	13	2	8922	−64	50	+8	64	267	1	P	Do.
			8919	−51	63	+20	53	242	2		
			8917	−35	79	−8	37	48	1		
			8917	−30	84	−8	32	48	1		
			8920	+46	160	−17	51	48	1		
			8914	+61	175	+24	62	48	3		
			8909	+68	182	−9	69	291	3		
			8908	+78	192	+18	78	170	1		
			(7)		(114)	(+4)		1,162	13		
9	12	30	8922	−58	43	+9	58	97	3	F	Do.
			8922	−53	48	+8	53	73	3		
			8922	−47	54	+6	47	267	3		
			8919	−38	63	+19	41	291	1		
			8921	−23	78	+8	27	48	5		
			8917	−16	85	−9	21	24	1		
			8914	+75	176	+24	75	48	2		
			8909	+81	182	−9	81	242	1		
			(6)		(101)	(+4)		1,090	19		
10	9	58	8922	−46	44	+9	46	48	2	F	Do.
			8922	−40	50	+8	40	73	3		
			8922	−35	55	+8	35	267	1		
			8919	−26	64	+19	30	267	2		
			8921	−12	78	+9	13	73	6		
			8921	−8	82	+9	11	97	4		
			(3)		(90)	(+3)		825	18		
11	10	56	8922	−32	44	+9	33	73	13	VG	Mt. Wilson.
			8922	−26	50	+8	27	145	11		
			8922	−22	54	+7	22	12	7		
			8922	−21	55	+8	22	242	1		
			8919	−12	64	+19	19	242	1		
			8921	+2	78	+9	6	97	17		
			8921	+6	82	+9	8	218	12		
			8917	+6	82	−9	14	36	11		
			(4)		(76)	(+3)		1,065	73		
12	10	0	8926	−81	342	+19	81	194	1	G	U. S. Naval.
			8924	−78	345	−14	79	194	1		
			8925	−75	348	−21	78	291	3		
			8923	−18	45	+11	20	48	6		
			8922	−12	51	+9	13	121	4		
			8922	−7	56	+8	9	242	3		
			8919	0	63	+19	16	194	2		
			8921	+14	77	+8	15	97	4		
			8921	+17	80	+8	18	109	4		
			8921	+21	84	+8	22	291	1		
			(7)		(63)	(+3)		1,781	29		
13	10	0	8925	−70	340	−21	74	145	1	G	Do.
			8925	−65	345	−21	68	97	6		
			8925	−60	350	−21	63	194	2		
			8926	−69	341	+18	70	194	1		
			8924	−65	345	−14	66	194	1		
			8924	−57	353	−12	60	12	6		
			8929	−46	4	−12	48	24	4		
			8928	−29	21	−12	33	12	3		
			8923	−8	42	+11	11	48	7		
			8922	+1	51	+9	6	61	11		
			8922	+7	57	+7	8	242	2		
			8919	+13	63	+21	22	206	12		
			8921	+27	77	+8	28	158	10		
			8921	+33	83	+8	34	339	7		
			8927	+34	84	−25	42	48	2		
			(10)		(50)	(+3)		1,974	75		

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR NOVEMBER 1947—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1947	*h* *m*		°	°	°	°				
Nov. 14	10 4	8932	−80	317	+14	80	194	1	F	U. S. Naval.
		8933	−80	317	+22	80	48	1		
		8925	−59	338	−21	63	170	1		
		8925	−51	346	−21	56	121	11		
		8925	−46	351	−21	51	206	1		
		8926	−55	342	+18	56	194	1		
		8924	−51	346	−14	54	194	2		
		8924	−47	350	−12	50	24	2		
		8929	−33	4	−12	36	12	2		
		8923	+3	40	+11	9	48	9		
		8922	+16	53	+8	17	24	8		
		8922	+20	57	+7	20	206	1		
		8919	+27	64	+20	32	170	8		
		8921	+40	77	+8	40	145	7		
		8921	+46	83	+8	46	388	4		
		8927	+47	84	−26	55	36	1		
		8927	+51	88	−25	57	12	20		
		8930	+52	89	−11	54	97	6		
		(12)		(37)	(+3)		2, 289	86		
16	12 44	8938	−76	293	−19	78	291	3	P	Mt. Wilson.
		8935	−66	303	−29	70	170	3		
		8933	−57	312	+23	60	48	2		
		8932	−53	316	+14	54	170	1		
		8925	−31	338	−20	37	145	10		
		8925	−22	347	−22	32	242	9		
		8925	−18	351	−22	31	291	2		
		8926	−29	340	+18	32	194	1		
		8924	−24	345	−15	30	194	1		
		8937	−20	349	+14	23	24	6		
		8936	−16	353	−11	21	73	6		
		8929	−4	5	−11	15	48	4		
		8934	+45	54	+32	51	73	3		
		8922	+48	57	+8	48	194	1		
		8919	+53	62	+20	55	12	5		
		(*)	+60	69	+15	61	12	3		
		8921	+70	79	+9	70	97	3		
		8921	+74	83	+9	74	291	1		
		8930	+76	85	−10	77	97	1		
		(16)		(9)	(+3)		2, 666	65		
17	10 45	8938	−63	294	−18	67	291	5	F	U. S. Naval.
		8935	−53	304	−29	60	145	2		
		8933	−44	313	+24	47	24	1		
		8932	−40	317	+14	41	194	1		
		8941	−31	326	−6	37	24	2		
		8925	−19	338	−21	31	97	4		
		8925	−13	344	−22	28	267	6		
		8925	−5	352	−22	24	291	1		
		8926	−16	341	+19	22	242	1		
		8924	−10	347	−16	21	145	2		
		8936	−2	355	−12	15	24	1		
		8929	+9	6	−12	17	24	2		
		8939	+27	24	−16	33	24	6		
		8922	+62	59	+6	62	194	1		
		(12)		(357)	(+3)		1, 986	35		
18	9 56	8943	−58	286	−9	60	12	1	F	Do.
		8938	−50	294	−19	54	242	6		
		8938	−47	297	−19	52	121	1		
		8942	−43	301	+19	45	61	2		
		8935	−41	303	−29	51	145	5		
		8933	−30	314	+24	35	24	1		
		8932	−27	317	+14	30	194	1		
		8941	−19	325	−6	22	121	5		
		8925	−5	339	−21	25	145	5		
		8925	0	344	−23	26	145	8		
		8925	+1	345	−22	25	61	2		
		8925	+7	351	−22	26	242	1		
		8926	−3	341	+19	17	206	1		
		8924	+3	347	−17	21	145	2		
		8936	+13	357	−12	20	24	3		
		8929	+24	8	−12	28	61	2		
		8939	+42	26	−16	45	145	5		
		8922	+75	59	+6	75	194	1		
		(14)		(344)	(+3)		2, 288	52		
19	12 20	8945	−67	263	+19	69	24	1	G	Do.
		8944	−51	279	−19	55	73	2		
		8943	−44	286	−9	46	121	6		
		8938	−36	294	−19	41	339	6		
		8938	−32	298	−19	37	145	1		
		8942	−30	300	+19	34	291	8		
		8935	−28	302	−29	42	121	7		
		8933	−16	314	+23	27	73	4		
		8932	−13	317	+14	17	194	1		
		8941	−5	325	−7	11	121	10		
		8940	−1	329	−16	18	16	9		
		8926	+10	340	+19	20	194	1		
		8925	+12	342	−25	29	218	18		
		8925	+20	350	−23	33	315	2		
		8924	+17	347	−17	26	109	2		
		8939	+55	25	−15	58	73	7		
		8939	+60	30	−16	62	121	8		
		(14)		(330)	(+2)		2, 548	93		

See footnotes at end of table.

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR NOVEMBER 1947—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1947	*h* *m*		°	°	°	°				
Nov. 20	14 14	8945	−52	263	+18	52	145	7	F	U. S. Naval.
		8944	−38	277	−20	43	48	1		
		8944	−31	284	−19	37	48	2		
		8943	−30	285	−10	32	170	9		
		8938	−22	293	−18	30	291	7		
		8938	−17	298	−19	27	145	1		
		8942	−16	299	+19	23	291	6		
		8935	−14	301	−29	33	97	4		
		8933	−2	313	+23	22	121	9		
		8932	+1	316	+13	12	194	2		
		8941	+8	323	−7	13	97	2		
		8926	+25	340	+18	30	194	1		
		8925	+25	340	−25	35	194	15		
		8925	+35	350	−24	42	339	1		
		8924	+31	346	−18	36	97	2		
		8936	+42	357	−12	43	16	2		
		8939	+72	27	−16	75	388	11		
		(14)		(315)	(+2)		2, 875	82		
21	10 24	8945	−39	265	+18	42	145	9	F	Do.
		8945	−34	270	+14	36	12	1		
		8944	−26	278	−20	33	48	6		
		8944	−19	285	−20	28	24	1		
		8943	−19	285	−9	22	194	10		
		8938	−9	295	−18	23	242	10		
		8938	−5	299	−19	22	145	1		
		8942	−4	300	+17	16	291	7		
		8935	−2	302	−29	31	97	4		
		8933	+10	314	+22	22	73	6		
		8932	+13	317	+13	17	194	1		
		8941	+19	323	−8	22	121	7		
		8926	+37	341	+17	40	170	1		
		8925	+37	341	−25	44	145	10		
		8925	+45	349	−24	50	291	2		
		8924	+42	346	−18	46	97	1		
		8939	+84	28	−16	84	291	4		
		(13)		(304)	(+2)		2, 580	81		
22	17 46	8946	−52	235	+7	53	48	2	G	Mt. Wilson.
		8945	−22	265	+19	27	121	13		
		8945	−17	270	+14	22	16	1		
		8944	−13	274	−20	27	24	3		
		8943	−3	284	−9	12	242	9		
		8938	+4	291	−18	22	194	12		
		8938	+11	298	−19	23	291	7		
		8942	+11	298	+17	18	291	6		
		8935	+12	299	−29	32	97	7		
		8932	+29	316	+13	31	194	3		
		8941	+34	321	−7	35	194	5		
		8941	+40	327	−6	41	97	7		
		8926	+52	339	+17	54	145	1		
		8925	+52	339	−25	58	170	6		
		8925	+60	347	−23	63	291	1		
		8924	+57	344	−18	60	73	1		
		(12)		(287)	(+2)		2, 488	84		
23	15 16	8948	−75	200	+25	76	12	2	F	U. S. Naval.
		8946	−39	236	+9	40	36	1		
		8946	−35	240	+6	35	61	2		
		8945	−14	261	+18	22	145	10		
		8945	−4	271	+15	14	48	4		
		8944	+1	276	−20	22	24	8		
		8943	+11	286	−11	17	145	9		
		8938	+12	287	−20	25	291	17		
		8938	+15	290	−18	25	97	1		
		8938	+24	299	−19	32	170	8		
		8935	+22	297	−29	37	121	3		
		8942	+25	300	+16	28	24	3		
		8942	+27	302	+17	32	339	1		
		8932	+42	317	+12	43	170	1		
		8947	+48	323	+25	52	24	1		
		8941	+50	325	−8	51	339	7		
		8926	+65	340	+17	66	145	1		
		8925	+65	340	−24	68	242	4		
		8925	+70	345	−23	72	218	2		
		8924	+70	345	−18	73	97	1		
		(14)		(275)	(+2)		2, 748	86		
24	12 1	8950	−70	194	+19	71	145	1	P	Mt. Wilson.
		8948	−60	204	+23	62	24	2		
		8949	−40	224	+1	40	48	3		
		8946	−29	235	+9	30	24	3		
		8946	−23	241	+7	25	36	1		
		8945	−1	263	+19	17	73	5		
		8945	+7	271	+18	17	73	6		
		8938	+22	286	−19	31	291	3		
		8938	+27	291	−18	33	388	4		
		8938	+37	301	−18	41	194	2		
		8943	+24	288	−11	27	97	5		
		8935	+36	300	−29	47	121	5		
		8942	+37	301	+16	40	24	3		
		8942	+39	303	+17	42	242	1		
		8932	+55	319	+13	56	145	1		
		8947	+58	322	+34	62	24	1		
		8941	+60	324	−7	61	194	2		

POSITIONS, AREAS, AND COUNTS OF SUNSPOTS FOR NOVEMBER 1947—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1947	h m		°	°	°	°				
Nov. 24	12 1	8941	+67	331	−7	68	194	7	P	Mt. Wilson.
		8925	+77	341	−24	80	291	2		
		8926	+79	343	+17	80	145	1		
		(14)		(264)	(+2)		2,773	58		
25	11 51	8951	−71	180	+25	73	121	2	G	U. S. Naval.
		8952	−68	183	−7	69	48	3		
		8953	−68	183	−22	70	170	10		
		8950	−57	194	+20	59	97	1		
		8948	−50	201	+27	55	12	2		
		8948	−43	208	+22	47	12	3		
		8949	−26	225	+3	26	121	10		
		(*)	−23	228	−14	27	6	1		
		8946	−15	236	+8	17	6	1		
		8946	−7	244	+6	9	36	1		
		8945	+15	266	+18	22	109	12		
		8938	+34	285	−18	39	339	8		
		8938	+49	300	−18	52	97	8		
		8943	+36	287	−11	38	61	7		
		8942	+49	300	+18	50	291	1		
		8935	+50	301	−29	57	97	4		
		8932	+65	316	+14	66	194	1		
		8941	+70	321	−8	71	242	1		
		8941	+78	329	−7	79	97	7		
		(15)		(251)	(+2)		2,156	83		
26	13 16	8951	−57	180	+26	60	97	3	F	Do.
		8952	−54	183	−7	56	24	1		
		8953	−53	184	−22	56	339	5		
		8950	−43	194	+20	45	61	1		
		8948	−38	199	+27	45	12	5		
		8948	−29	208	+22	35	6	1		
		8948	−29	208	+27	37	12	5		
		8949	−13	224	+3	13	48	5		
		8946	+7	244	+6	10	48	4		
		8954	+10	247	−30	33	73	6		
		8945	+29	266	+19	32	61	6		
		8945	+35	272	+15	37	48	5		
		8938	+48	285	−19	52	339	10		
		8938	+52	289	−11	54	24	3		
		8938	+54	291	−20	58	436	12		
		8938	+63	300	−18	67	145	4		
		8935	+61	298	−28	65	48	4		
		8942	+63	300	+18	64	291	1		
		8932	+79	316	+13	79	145	1		
		(13)		(237)	(+2)		2,257	82		
27	11 46	8951	−43	182	+26	48	61	1	P	Do.
		8953	−41	184	−22	46	339	10		
		8952	−40	185	−7	42	61	1		
		8950	−29	196	+19	33	73	1		
		8954	+23	248	−30	38	194	5		
		8945	+47	272	+15	48	145	7		
		8938	+60	285	−20	62	436	7		
		8938	+65	290	−19	67	388	6		
		8942	+75	300	+17	76	291	1		
		(8)		(225)	(+1)		1,988	39		
28	11 21	8951	−30	182	+26	37	48	3	F	Do.
		8953	−29	183	−22	36	291	11		
		8952	−27	185	−7	29	61	1		
		8950	−16	196	+19	24	48	1		
		8948	−16	196	+27	31	36	3		
		8948	−5	207	+25	25	24	1		
		8955	−6	206	−19	21	48	4		
		8949	+15	227	+3	15	61	4		
		(*)	+30	242	−19	35	24	2		
		8954	+36	248	−30	46	145	4		
		8945	+60	272	+15	60	97	3		
		8938	+73	285	−20	74	485	8		
		8938	+79	291	−19	79	436	5		
		(11)		(212)	(+1)		1,804	50		
1947	h m		°	°	°	°				
Nov. 29	11 46	8958	−56	142	−15	57	73	3	F	U. S. Naval.
		8951	−22	176	+26	32	24	7		
		8951	−18	180	+26	31	48	7		
		8953	−16	182	−22	28	194	18		
		8952	−14	184	−7	17	36	1		
		8950	−2	196	+19	18	24	1		
		8948	−2	196	+27	26	97	12		
		8948	+8	206	+25	25	24	3		
		8956	+7	205	−24	26	12	1		
		8955	+8	206	−19	21	24	6		
		8949	+26	224	+2	26	6	2		
		8954	+51	249	−30	57	61	1		
		8945	+73	271	+17	73	24	2		
		8938	+88	286	−17	88	97	1		
		(12)		(198)	(+1)		744	65		
30	11 34	8958	−42	143	−15	44	330	8	G	Do.
		8951	−11	174	+25	17	48	8		
		8951	−5	180	+26	25	12	5		
		8953	−3	182	−22	23	194	20		
		8952	+1	186	−7	8	73	4		
		8950	+11	196	+19	21	24	1		
		8948	+12	197	+27	30	61	6		
		8948	+17	202	+25	29	73	5		
		8956	+17	202	−28	33	73	9		
		8955	+27	212	−19	32	12	1		
		(*)	+33	218	+12	34	12	2		
		8954	+65	250	−30	69	12	1		
		(10)		(185)	(+1)		933	70		

Mean daily area for 29 days =1,761
Mean 10g+s for 29 days =154.6

*Not numbered.
VG=very good; G=good; F=fair; P=poor.

PROVISIONAL RELATIVE SUNSPOT NUMBERS FOR NOVEMBER 1947

[Dependent on observations at Zurich Observatory and its stations at Locarno and Arosa.]

November 1947	Relative numbers	November 1947	Relative numbers	November 1947	Relative numbers
1	101	11	65	21	190
2	98	12	90	22	180
3	74	13	85	23	171
4	80	14	107	24	180
5	81	15	192	25	190
6	76	16	170	26	193
7	91	17	168	27	160
8	69	18	177	28	100
9	72	19	180	29	113
10	55	20	182	30	131

Means, 30 days=127.4.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, November 1947

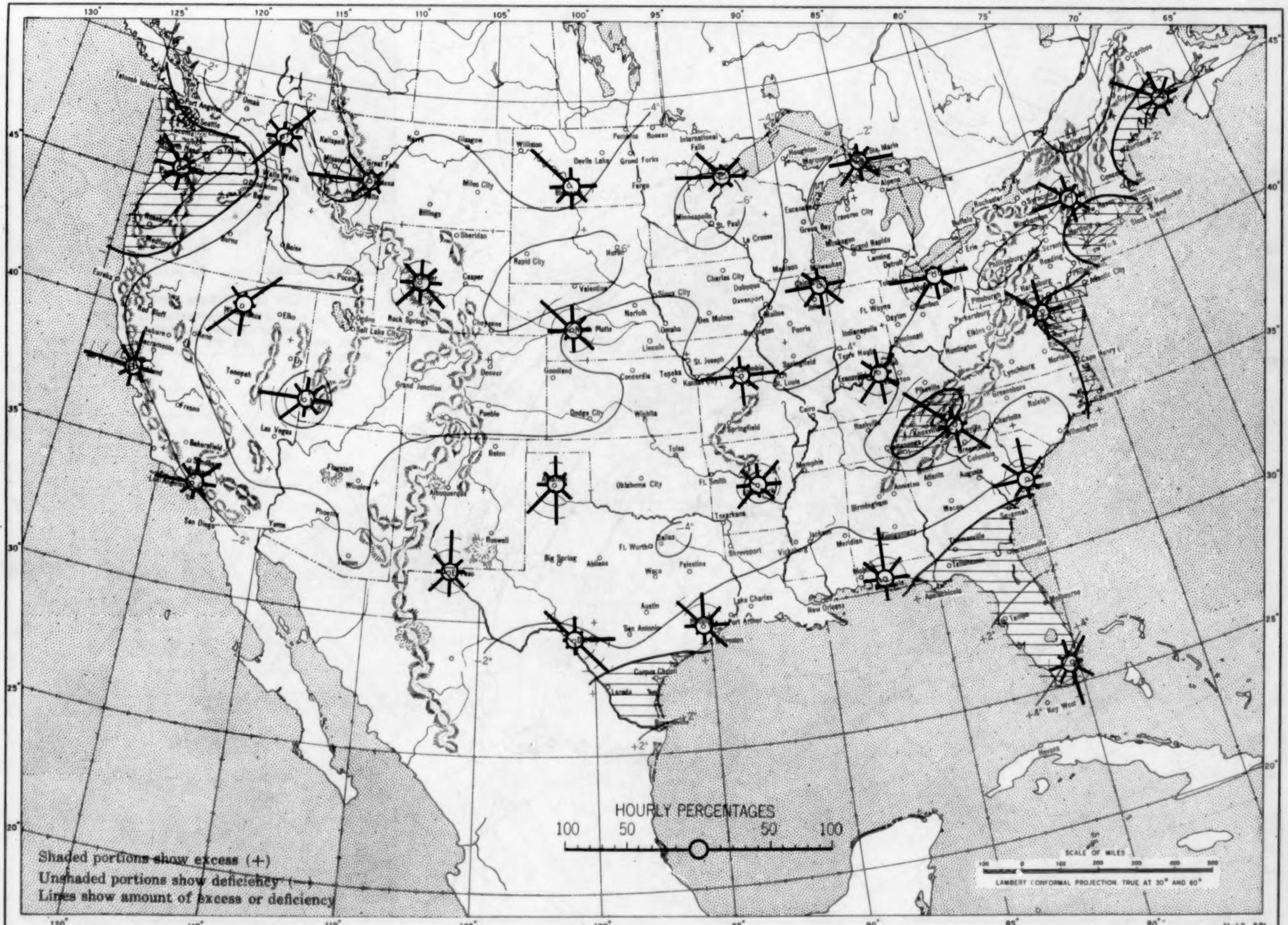
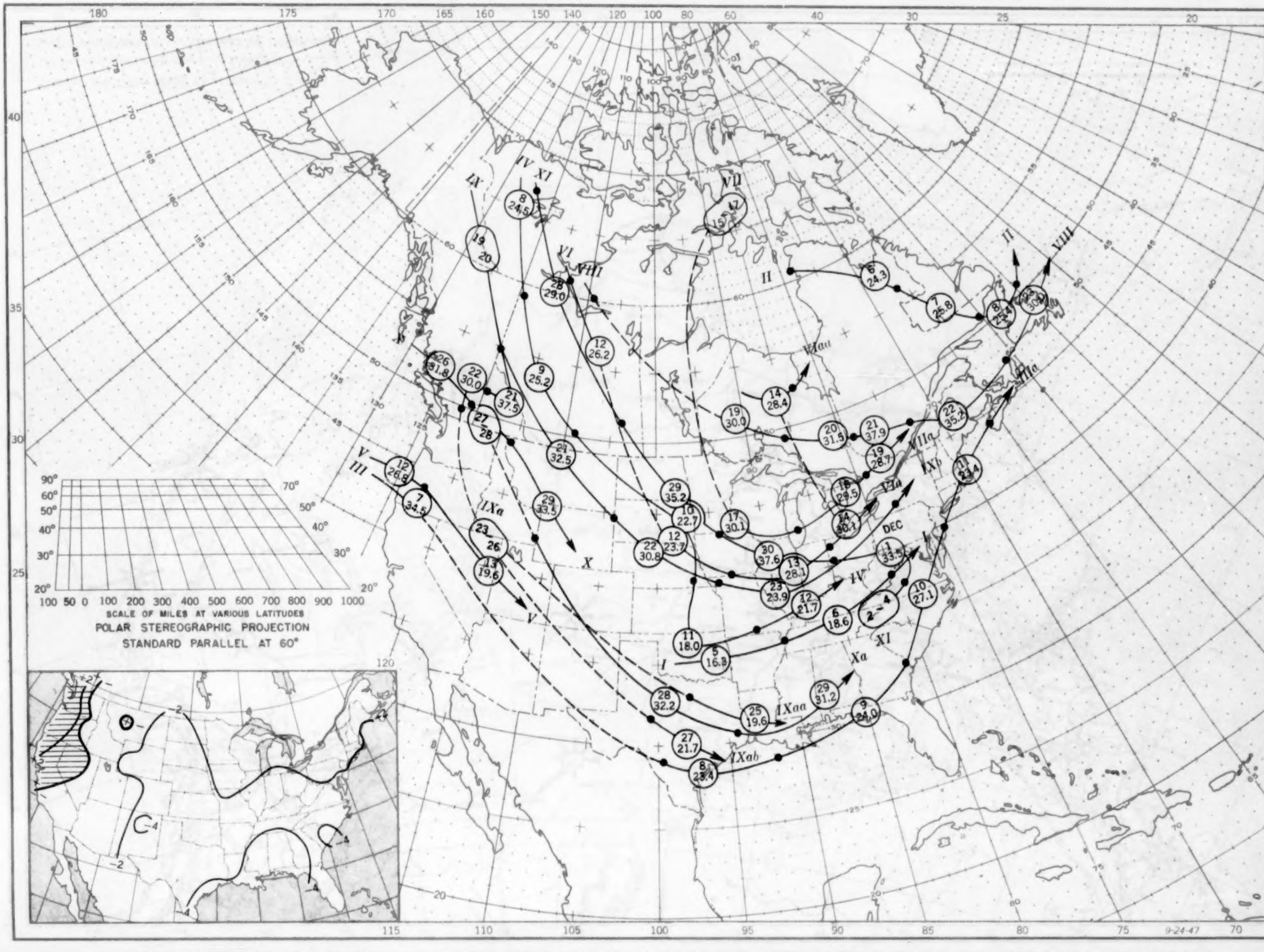
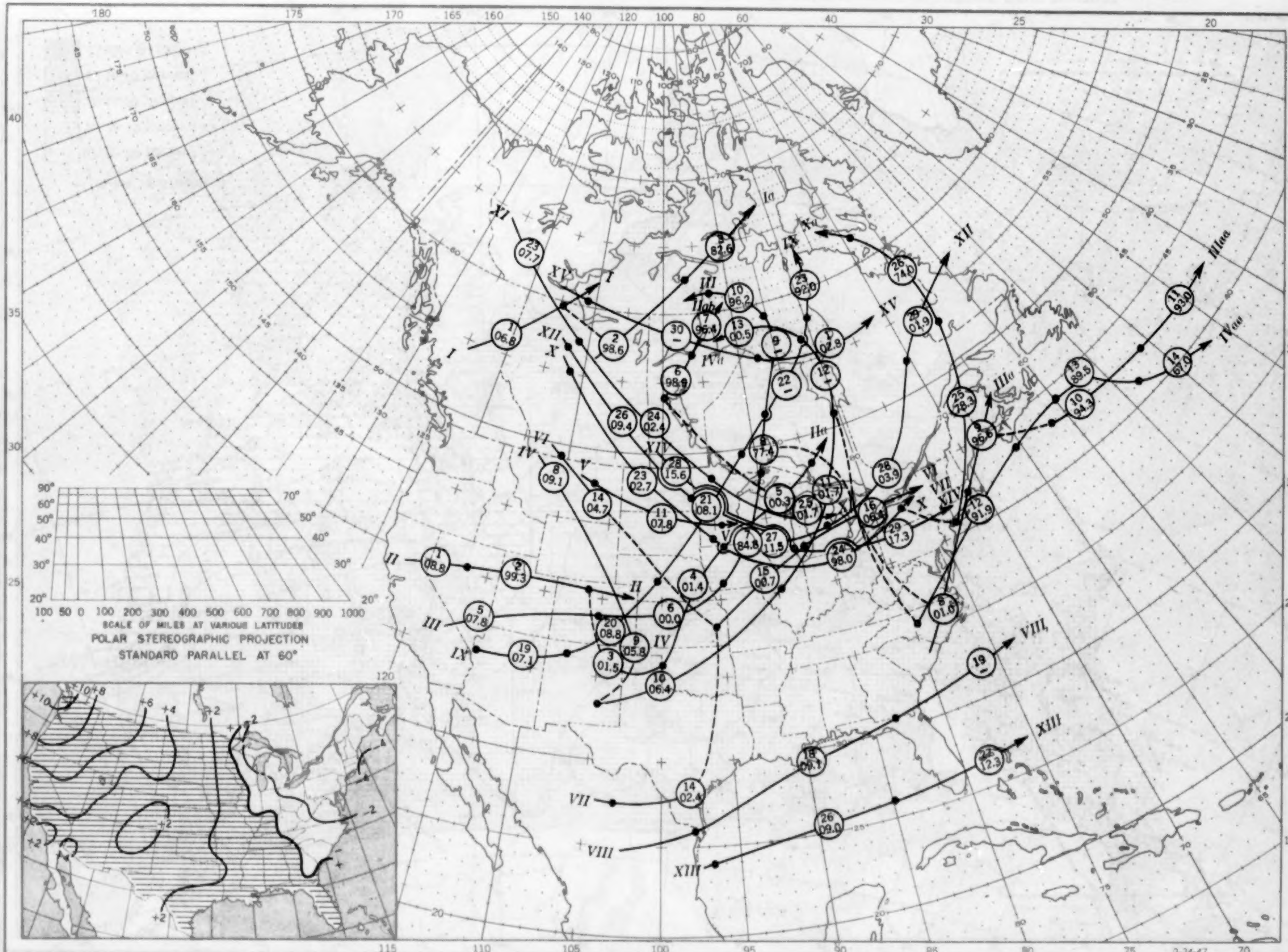


Chart II. Tracks of Centers of Anticyclones, November 1947. (Inset) August Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 7:30 p. m. (75th meridian time)

Chart III. Tracks of Centers of Cyclones, November 1947. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 7:30 p. m. (75th meridian time)

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, November 1947

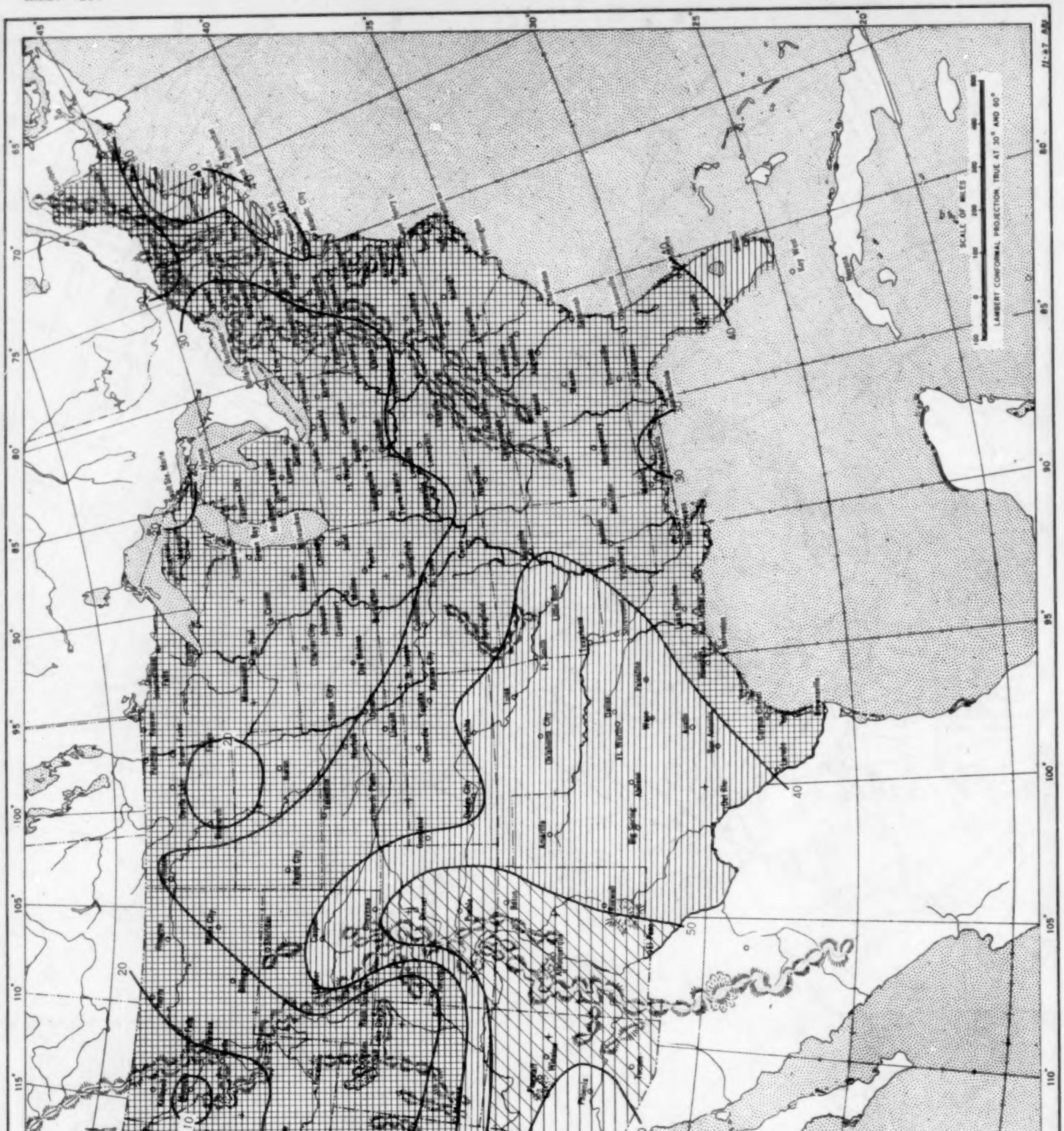
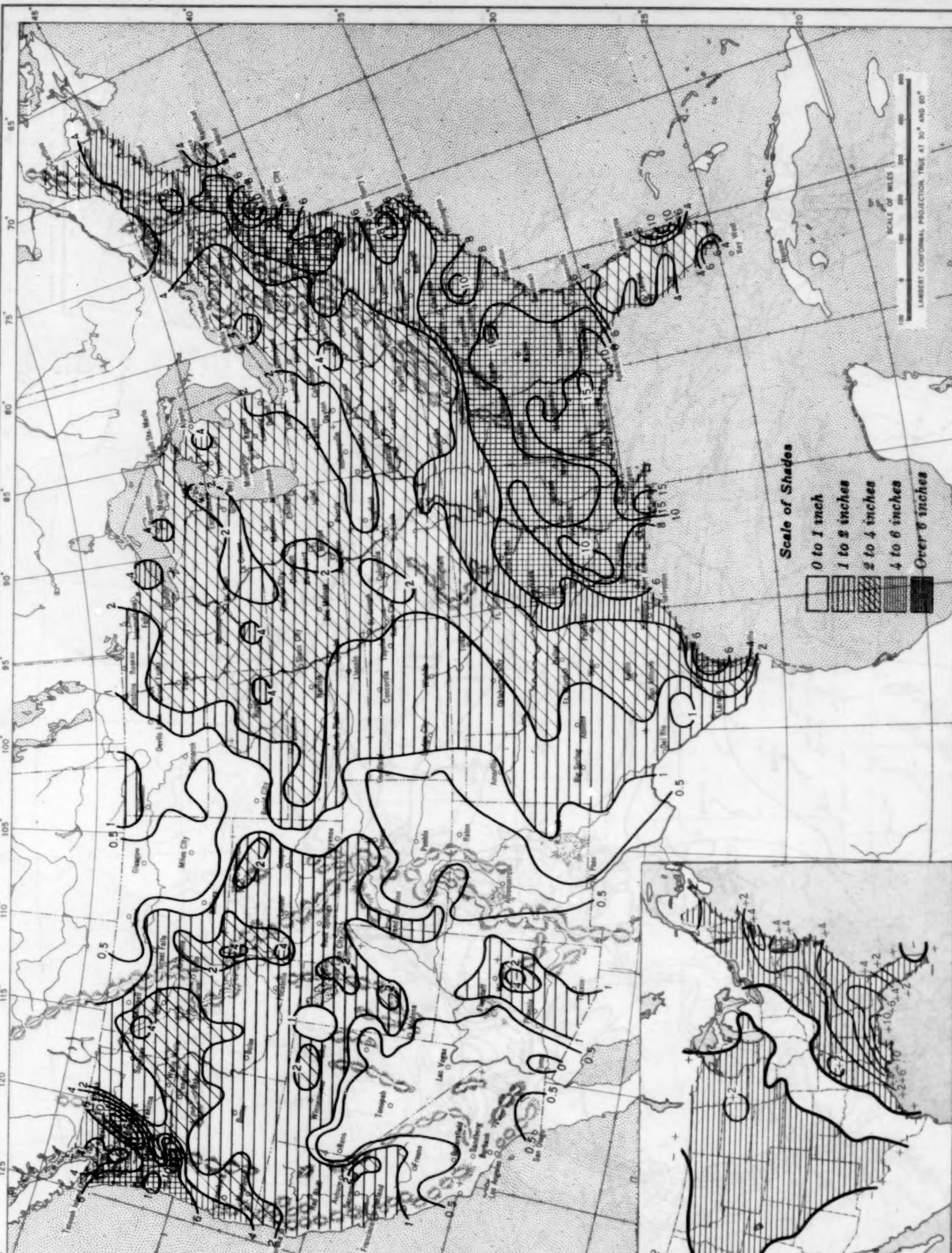


Chart V. Total Precipitation, Inches, November 1947. (Inset) Departure of Precipitation from Normal



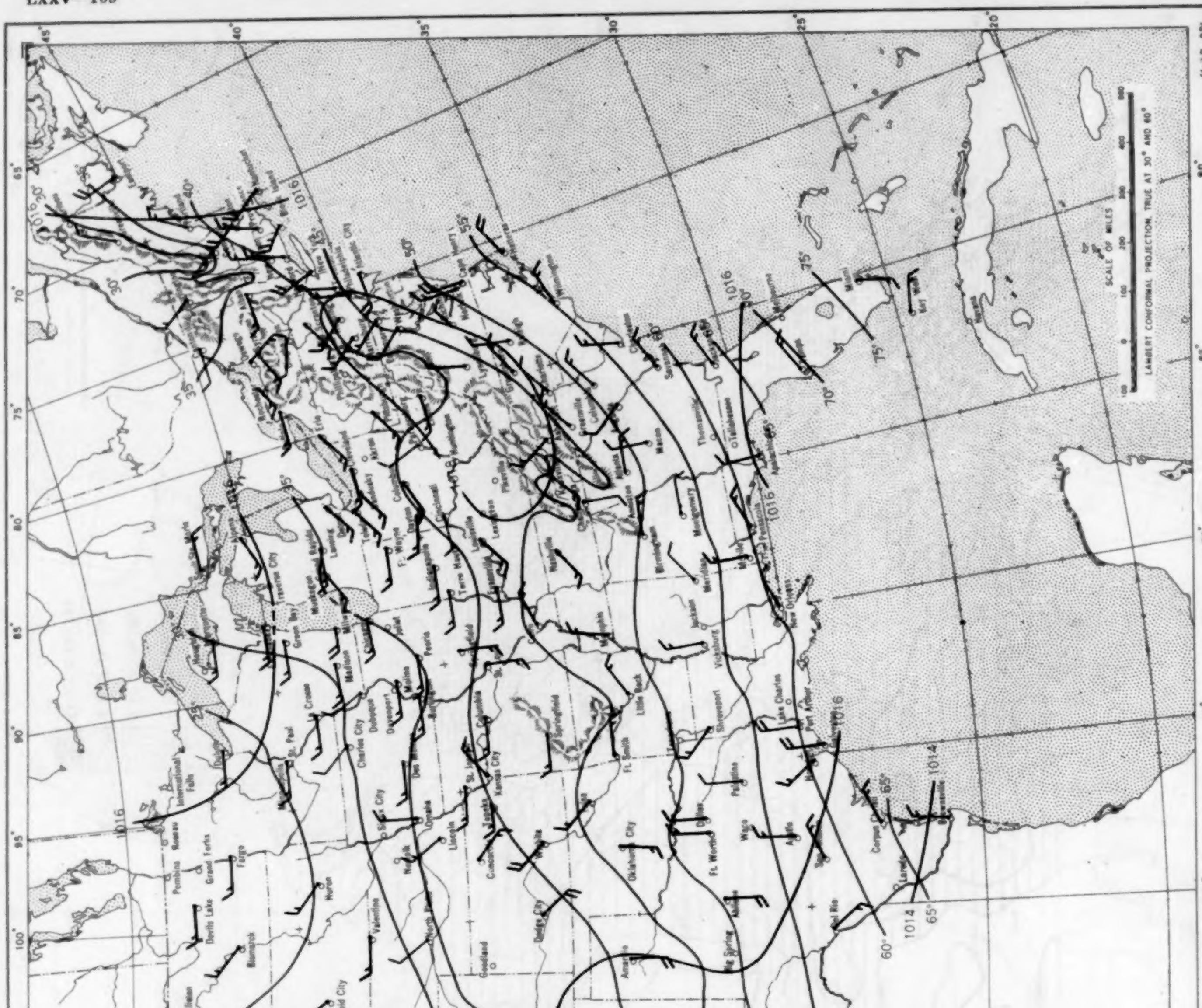


Chart VI. Isobars (mb.), at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, November 1947

Chart VII. Total Snowfall, Inches, November 1947.

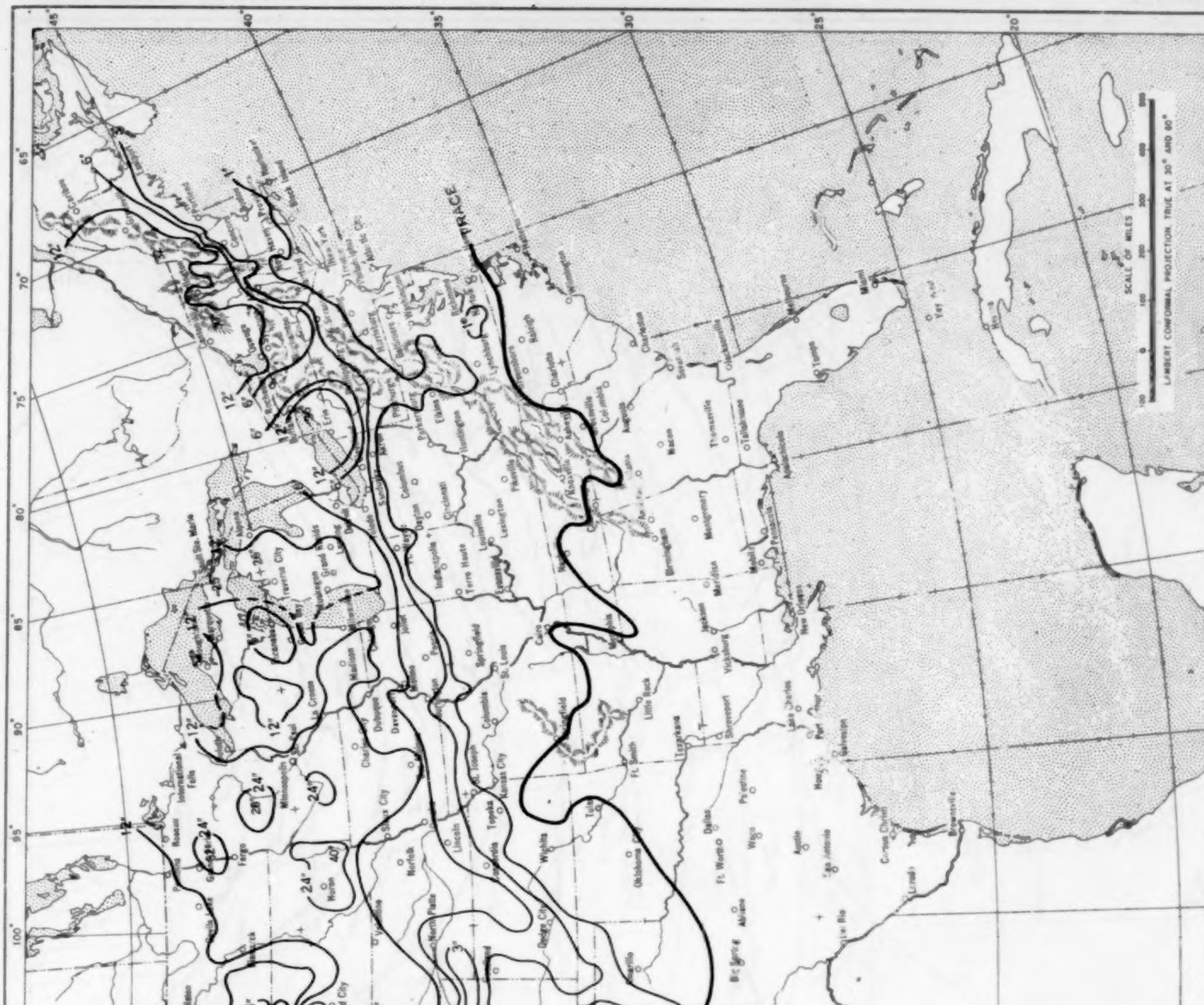
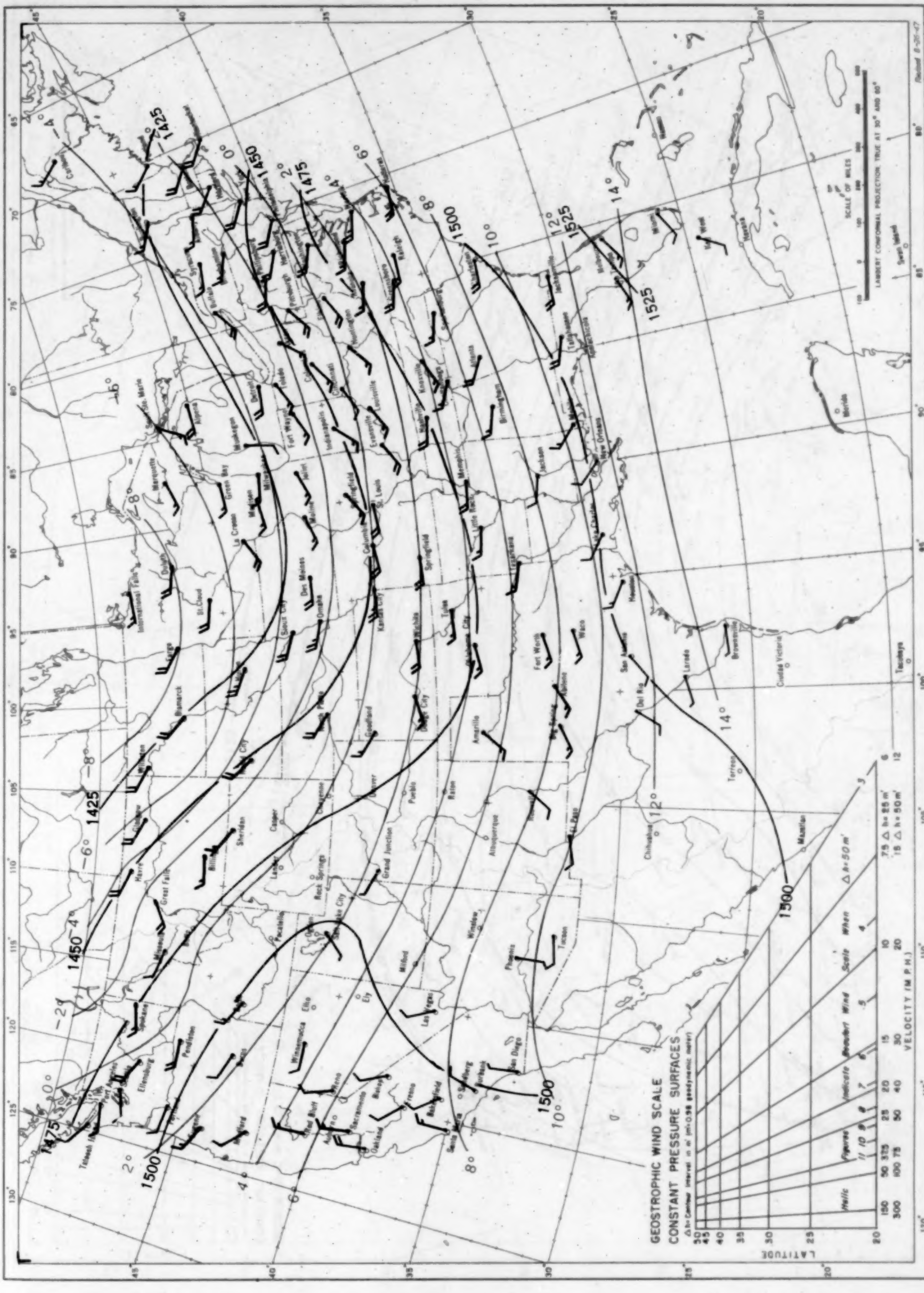


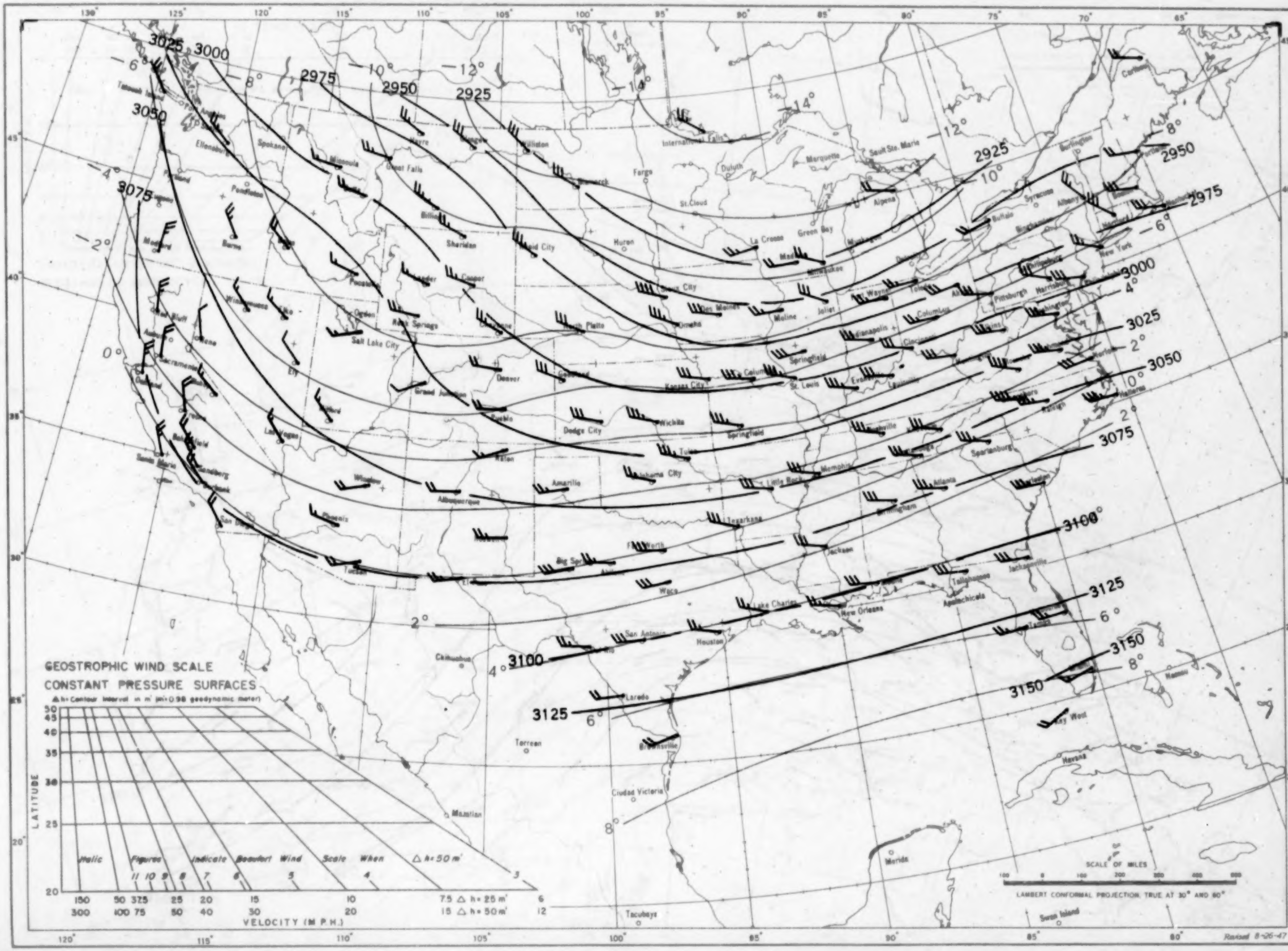
Chart VIII. November 1947. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

Chart VIII, November 1947. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m.s.l.)



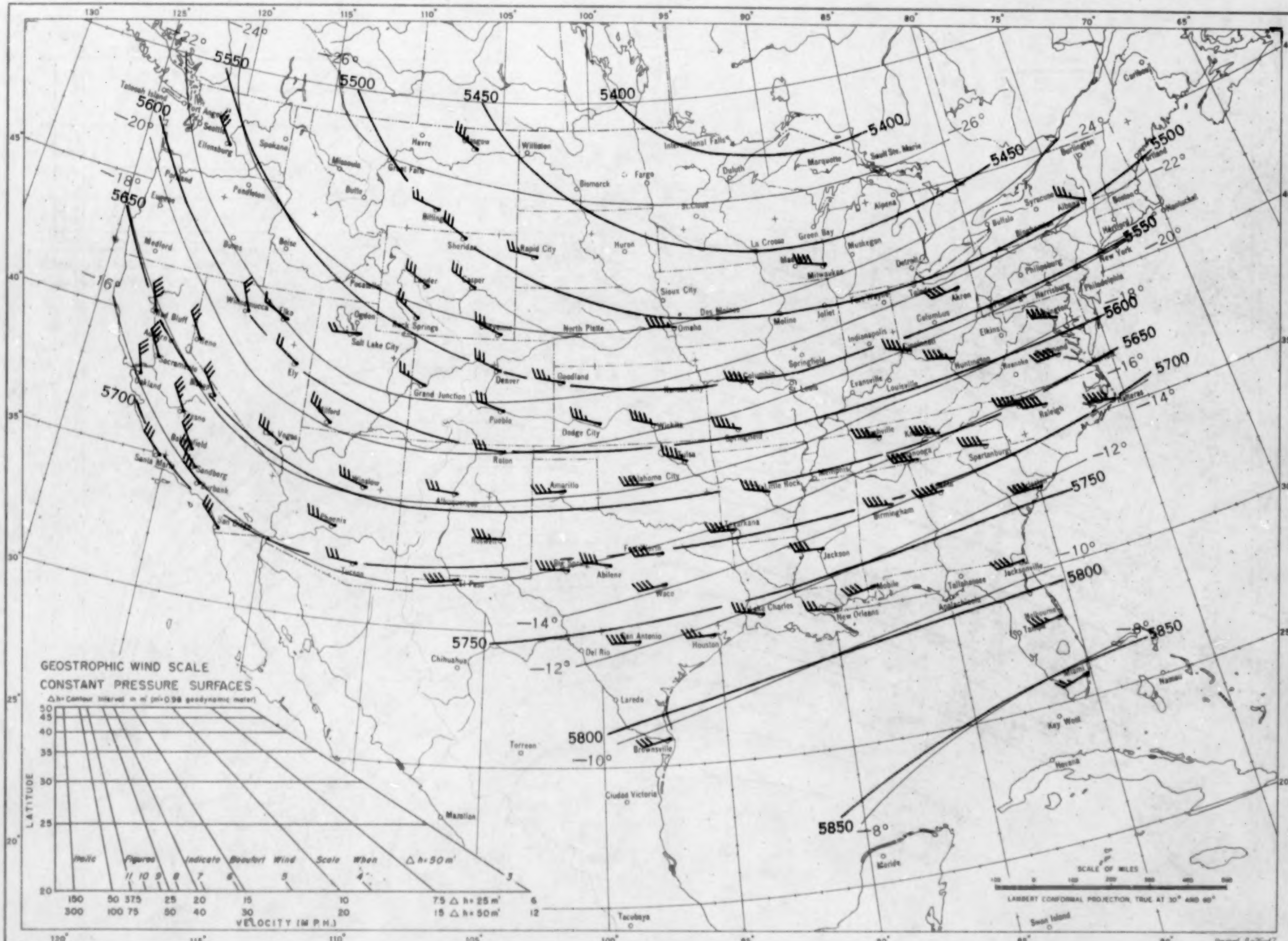
Contour lines and isotherms based on radiosonde observations at 0300 G.C.T., and winds based on pilot balloon observations at 2200 G.C.T.

Chart IX, November 1947. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m.s.l.)



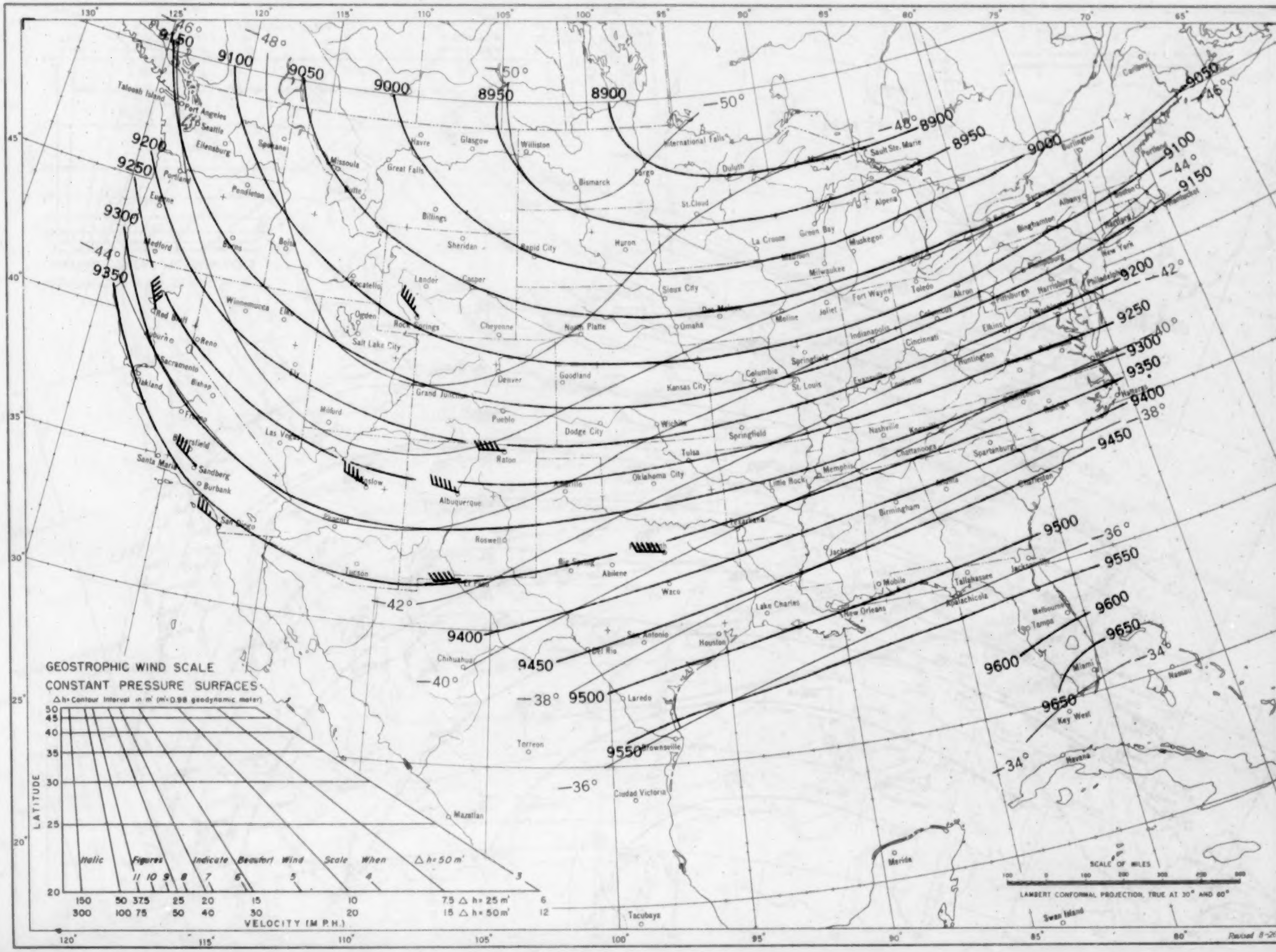
Contour lines and isotherms based on radiosonde observations at 0300 G.C.T., and winds based on pilot balloon observations at 2200 G.C.T.

Chart X, November 1947. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m.s.l.)



Contour lines and isotherms based on radiosonde observations at 0300 G.C.T., and winds based on pilot balloon observations at 2200 G.C.T.

Chart XI, November 1947. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m.s.l.)



Contour lines and isotherms based on radiosonde observations at 0300 G.C.T., and winds based on pilot balloon observations at 2200 G.C.T.